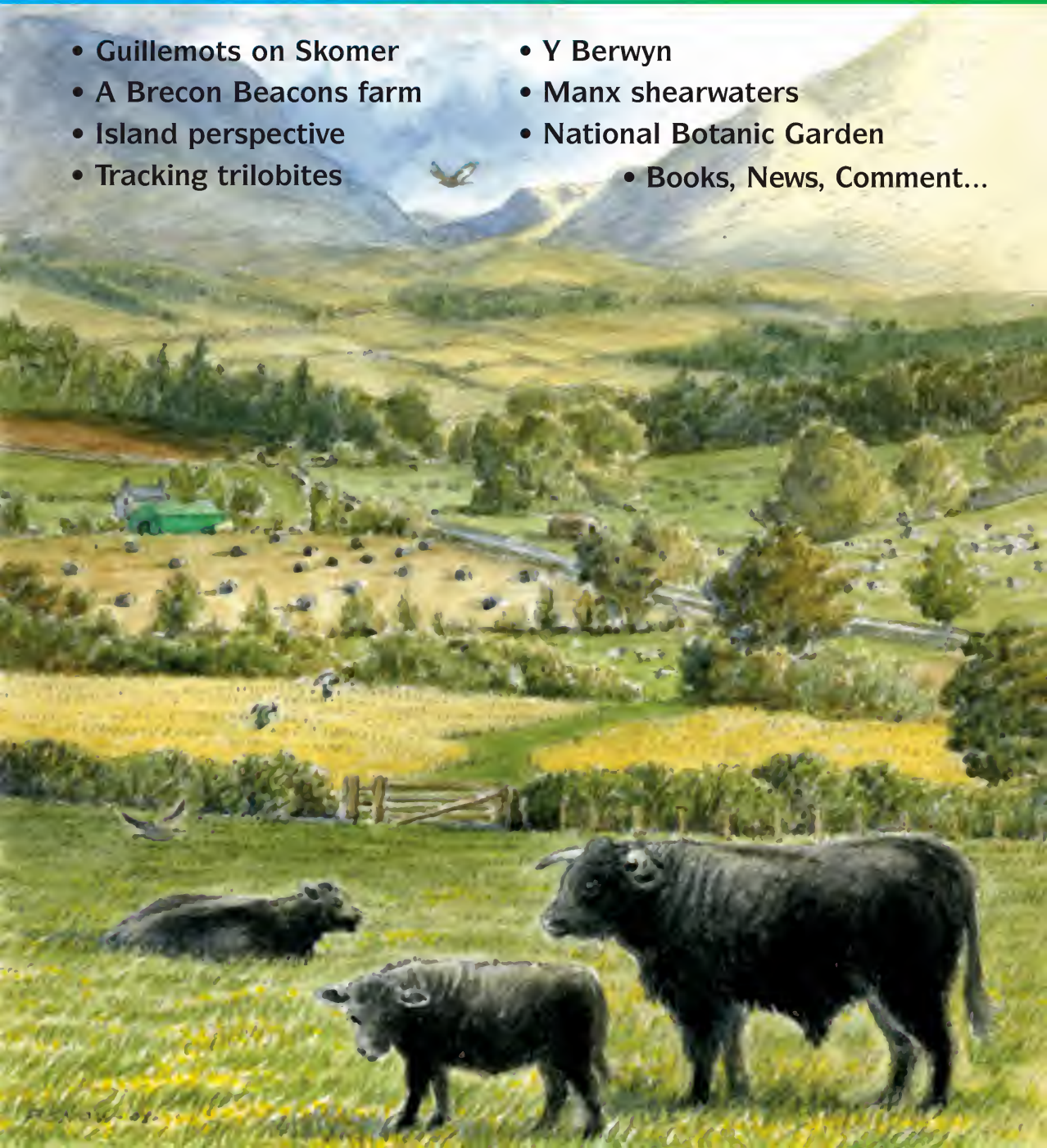
NATUR CYMRU
Nature of Wales

Number/Rhif 30 • Spring/Gwanwyn 2009

- Guillemots on Skomer
- A Brecon Beacons farm
- Island perspective
- Tracking trilobites
- Y Berwyn
- Manx shearwaters
- National Botanic Garden
- Books, News, Comment...



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Tanysgrifiadau / Subscriptions:
Unigolyn / Individual:
Sieciau /Cheques: £14.00
Debyd Uniongyrchol / Direct Debit: £13.00
Sefydliad / Organisation: £25.00
Sieciau yn daladwy i /
Cheques payable to:
Natur Cymru Ltd.

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NATUR CYMRU
The Nature of Wales

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Natur Cymru is published four times per year, in March, June, September and December. Articles are published in the language in which they are submitted. They are followed by summaries in the other language, and some regular columns appear in both languages. If you would like to receive a translation of any article, please contact the editor.

Natur Cymru is intended to promote the exchange of information about biodiversity and encourage debate. If you have information, ideas for articles or artwork which you think might be of interest to readers, please contact the Editor.

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Natur Cymru is printed on chlorine-free paper sourced from managed and sustainable forests.

Llun y clawr / Front cover:
Farming with Welsh Black Cattle
Philip Snow
See page 48 for details of an exhibition of Philip Snow's work.
ISSN 1742-3740

Argraffwyd gan/Printed by: LS Printworks, Amlwch • Dylunio gan/Design by: Mel Parry Design, melparry1@tiscali.co.uk

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NATUR CYMRU GOLYGYDDOL

Ers amser maith, mae ynysoedd Cymru a'u nythfeydd o adar môr wedi denu ymchwilwyr o'r radd flaenaf. Yn wir, mae eu swyn wedi sicrhau bod ymchwilwyr yn ymroddi i gynnal astudiaethau hirdymor yno sydd, ymhen amser, yn esgor ar dystiolaeth bwysig yn ymwneud ag achosion ac effeithiau newidiadau amgylcheddol. Mae pob un ohonom yn elwa ar hyn. Mae'n dangos bod Cymru yn lle gwych i gynnal gwaith ymchwil o'r fath, ac mae'n arwydd hefyd fod cywain gwybodaeth a dysgu am ein byd natur cyfoethog yn bwysig dros ben inni.

Fel palod, mae gwylogod yn agos iawn at ein calonnau. Mae'r cipolwg a rydd Tim Birkhead inni ar gymdeithas y gwylogod yn dangos pa mor dda ydyn nhw am fyw mewn cymunedau mawr a pha mor bwysig yw hi i'r adar gyrraedd gwth o oedran. Wrth iddyn nhw ddychwelyd i'w clogwyni nythu nid nepell o 'nghyrraedd, rwy'n edrych ymlaen yn barod at fy ymweliad nesaf – ond alla' i ddim edrych arnyn nhw yn yr un goleuni byth eto.

Mae bywyd dirgel adar drycin Manaw ar y môr yr un mor gyfareddol a rhyfeddol, ac wrth adrodd yr hanes daw gwyddoniaeth ac angerdd ynghyd unwaith eto. Gan fod bron i hanner poblogaeth y byd o adar drycin Manaw yn nythu yma yng Nghymru, yn sicr mae gennym reswm dros ymfalchïo. A beth am lystyfiant ein hynysoedd, a'r cysyniad fod ein hynysoedd gorllewinol yn gorwedd ar hyd morffordd ddiwylliannol? Llwyddodd yr erthygl bryfoclyd yma i'm hatgoffa o'r dimensiwn diwylliannol enfawr sy'n perthyn i ynysoedd. Yn wir, o ystyried y golygfeydd eang a gawn, fe sylweddolais mai dyma un o brif fanteision diwylliant Cymru – gan ein bod nid nepell o'r môr, ac ar ymyl Prydain ac Ewrop, mae ein safbwyntiau'n gallu bod yn ecsentrig (yn yr ystyr orau).

Parodd erthygl arall imi feddwl am safbwyntiau hefyd, er mai rhai tymhorol yn hytrach na rhai daearyddol neu ddiwylliannol oedd y rhain. Efallai fod trilobitau wedi diflannu, ond maen nhw wedi gadael llwybr ar eu hôl y gall naturiaethwyr y bydd sydd ohoni eu dilyn. Er nad ydyn nhw'n perthyn i'n hoes ni, maen nhw wedi cyfrannu at y presennol. Yn yr un modd, a fydden ni'n bod yn awr heb stromatolitau? Wrth gynhyrchu'r creigiau rhyfedd hynny, fe newidiodd y micro-organeddau yma'r hinsawdd, gan ei gwneud yn bosibl i rywogaethau cymhleth, fel ni, fyw ar y blaned. Beth ydyn ni'n ei wneud â'r etifeddiaeth yma, tybed?

Ond os bydd *Homo sapiens* yn gwneud smonach o bethau, o leiaf fe all y stromatolitau symud o'u lagynau anghysbell wrth i'r moroedd fynd yn boethach ac yn fwy hallt ac wrth i fwy a mwy o garbon deuocsid lenwi'r atmosffer, gan ddechrau ar y gwaith o ailocsideiddio'r atmosffer unwaith eto. Ond fe fydd yn rhaid disgwyl am amser maith cyn i ffurf fwy deallus ar fywyd gael cyfle i arfer i'r amgylchedd a byw o fewn ei derfynau.

I gloi, pleser yw cael neilltuo rhywfaint o le i blanhigion, gan gynnwys y gwaith pwysig sy'n cael ei wneud gan yr Ardd Fotaneg Genedlaethol i warchod planhigion prin ac ymdrechion calonogol un newydd-ddyfodiad i ffermio sydd wedi penderfynu rhoi blaenoriaeth i blanhigion. Mae Ruth Watkins yn troedio llwybr anodd ond gwerth chweil, oherwydd mae'r planhigion a'r bywyd gwyllt a geir ar y dolydd gwlyb a'r caeau iach sydd ganddi'n ddolen gyswllt werthfawr â man cychwyn ffermio. Dyma gyfoeth o wybodaeth ddihysbydd – adnodd biolegol, diwylliannol a gwyddonol. Rhaid i ffermio gwmpasu popeth sy'n gwneud y tir a'r alwedigaeth yn bwysig i'r gymuned ehangach, yn ogystal â chynhyrchu bwyd da. Dyma fydd thema rhifyn yr haf.

James Robertson

NATUR CYMRU EDITORIAL

Welsh islands and their seabird colonies have long attracted outstanding research talent. The fascination they exert has helped to keep researchers committed to long-term studies, which over time become important evidence of the causes and effects of environmental change. We all benefit, not because these studies generate income for local communities, although they do, but because they enhance our reputation as a rewarding place to do research; richly endowed with nature, ours is a country where learning counts, a culture sympathetic to the pursuit of knowledge and understanding.

Common guillemots have what I will call 'puffin appeal' but with more sophistication. Tim Birkhead's wonderful insight into guillemot society shows just how good they are at communal living, and how important it is for the population that they live to a ripe old age. As they return to their breeding cliffs not far from me, I look forward to my next visit, but I won't be looking at them in quite the same way again.

The secret life of Manx shearwaters at sea is equally astonishing, and in its telling there is another meeting between great science and passion. With nearly half the world's Manxies breeding in Wales, we have every reason to take pride in this unfolding story. And so to island vegetation, and the concept that our western islands lie along a cultural seaway. This thought-provoking article reminded me of the huge cultural dimension to islands. Indeed, in thinking about the wide island views we enjoy 'from the edge of the picture', I realised that this is one of the great benefits of Welsh culture; close to a great ocean, on the edge of Britain and Europe, its perspective is eccentric in the best sense.

Another article provoked similar thoughts about perspective, although temporal, rather than geographical or cultural. Trilobites may have vanished, but they have left behind a trail for the modern naturalist to follow. Not of our time, they nevertheless contribute to the present. Similarly, would we be here without the stromatolites? In the process of producing strange lumpen rocks, these micro-organisms changed the climate, making the planet habitable for complex species such as ourselves. What are we doing to that life-giving legacy?

At least if *Homo sapiens* messes it all up, the stromatolites can always move out of their remote lagoons when the seas become saltier and hotter, and the atmosphere is dominated by carbon dioxide, and they can start the process of re-oxygenating the atmosphere all over again. It will be a long wait, though, before a more intelligent life-form has a chance to 'get the environment' and live within environmental limits.

Finally, I am delighted to devote some space to plants; both the excellent rare plant conservation work being carried out at the National Botanic Garden, and the heartening efforts of a newcomer to farming, who is putting wild flowers first. Ruth Watkins is on a difficult but rewarding path, for the plant communities and wildlife of her wet meadows and heathy fields form a precious link with the origins of farming. This is a store of untapped knowledge, a biological, cultural and scientific resource. Farming needs to encompass the many values which the land and its occupation hold for the wider community, in addition to the production of good food. This will be the theme for the summer edition.

James Robertson

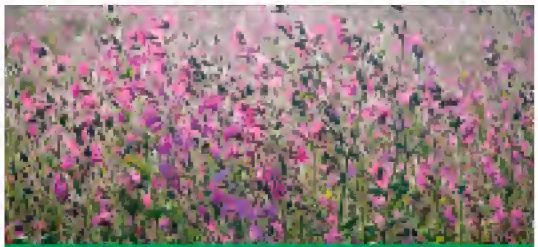
Mike Alexander

From the edge of the picture - an island perspective

Though apparently eccentric and particular, islands offer in microcosm wider insights into how people and wildlife might belong together. The view from Skomer, Skokholm and Ramsey offers a wider perspective from the edge of the picture. This, JOHN RODWELL suggests, can help us live with change, manage with confidence, seize the moment and bring a salty savour to a sense of place.

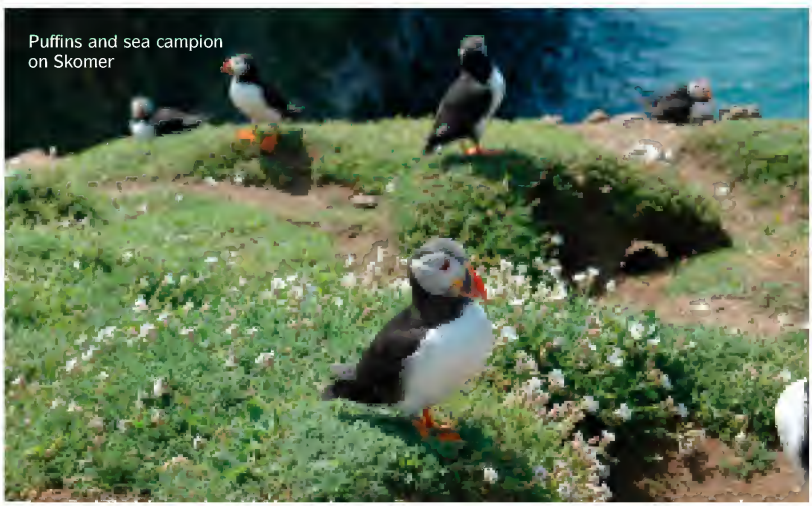
Being marooned on an island is probably the best place to begin since this gives you a real idea of how precarious life can be on the edge of things. For me, that was in 1963 when I was stuck on Ynys Enlli, part of a school trip trapped by heavy seas between the island and the Llŷn from where the small boat had set out with its phut-phut engine and ominous bucket for bailing. It was my first encounter with this ocean edge of Wales, its island cliffs and seabirds. Over forty years later, I have recently had the chance to taste the island life again and, from Skomer, Skokholm and Ramsey this time, to consider how people and wildlife can belong together in these places.

Much of the vegetation that belongs on these islands is typical of the equable oceanic climate and spray-splashed rocky edge of the north-western fringe of Europe. The sequence of crevice vegetation and maritime grasslands behind, best seen on Ramsey and Skokholm, reflects a decreasing input of salt-spray over deepening soils that, derived from volcanic and sedimentary sandstones, are mostly acidic. Inland, on deeper soils and out of reach of spray, there can be bracken in such sequences, its stands marked out by a magnificent spring show of bluebells *Hyacinthoides non-scripta* and afterwards red campion *Silene dioica*.


Red campion

Places of process

Among such zonations, seabirds have made their homes and Skomer and Skokholm, where internationally important breeding populations numbering hundreds of thousands occur, have been memorably described as 'bird slums' - as if their impact were so intensive as to render the plant cover an indescribable mess. Certainly, the effects of burrowing by birds - and by rabbits - can impart to the bracken vegetation a baffling dynamic of local societies of sheep's sorrel *Rumex acetosella*, wood sage *Teucrium scorodonia* and Yorkshire fog *Holcus lanatus*. Elsewhere, under-burrowed cliff-top thrift *Armeria maritima* has been turned into decaying little hedgehogs that have got overgrown by sea campion *Silene uniflora*, a startling shift from spring-time pink to white. But actually, such peculiar processes make the islands valuable living laboratories for studying the demography of plant populations in disturbed habitats.


Puffins and sea campion on Skomer

Like all landscapes, the islands are places of process, much of the dynamic resulting from human impacts, direct and indirect, upon their scenery and vegetation. Long before they were nature reserves, these Welsh islands had an older significance for human populations, though their settlement and exploitation have been complex and uneven, dependent upon the islands' size, their isolation and the provision of a water supply. Ramsey and Skokholm both show

signs of Mesolithic occupation, but not until late prehistoric times was settlement on the islands intensive, perhaps because of mainland population pressure. Iron Age/Roman occupation is most evident on Skomer, with lynchets, field boundaries, stock pounds and a dammed pond - signs of an agricultural economy that may have sustained up to 200 people. In the medieval period, tenant farmers worked the islands and religious orders became important in their life, with outpost chapels of St David's cathedral on Ramsey. And subsistence stock-rearing continued into relatively recent times, with arable cultivation occurring on Skomer and Skokholm into the 1940s and on Ramsey until 1963.

The end of farming

The transition from farming to nature conservation in the lives of the islands has left its own legacy, and considerable challenges. It is clear that the more recent private owners of the islands sometimes had an interest in conservation of their wildlife, but now their status is more formalised. Skokholm has been leased from the Dale Estate since 1948, and is now owned by the South & West Wales Wildlife Trust, while Skomer was bought by the Nature Conservancy in the late 1950s and is managed by lease to the Trust. Ramsey was bought by the Royal Society for the Protection of Birds in 1992.

Changes in the intensity of grazing since the end of farming on the islands and the start of more serious conservation management have markedly influenced their landscapes, but the situation has been complicated by the occurrence, often in huge numbers, of the rabbits which are voracious herbivores. These animals were introduced early onto the islands, perhaps in the 12th century on Skokholm where warrening for the earls of Pembroke provided an important meat source. Their fluctuating populations, as epidemics, summer droughts and harsh winters take their toll, are reflected in changes in the appearance of the vegetation.

Where grazing occurs on cliff-tops, it always affects the zonations of maritime plant communities, favouring grasses and rosette herbs tolerant of repeated cropping, and limiting the occurrence of heath which can be an important part of such coastal sequences on more acidic soils beyond the limit of salt-spray. On ungrazed clifftops on the Pembrokeshire coast you can see more maritime heath with vernal squill *Scilla verna*, and behind this the more widely distributed oceanic mainland heath with western gorse *Ulex gallii*.

Aerial photography shows that, on Skomer, after an initial resurgence of heath with the end of stock-grazing from 5% of the island in 1947 to 8% in 1969, the extent of sub-shrub vegetation decreased again to 6% in 1983 and is now only 1%. Much of this loss must be due to rabbit grazing. On Skokholm,

Ramsey Sound

most of the heath had been lost by 1964 and the last remaining patch succumbed to a storm drench of salt-spray in recent years. Though there has been encouraging success in regenerating heather in exclosures on Skomer, enough to bring an end to the need for experiment, only on Ramsey do extensive tracts of heath now remain on these islands, some of the best in the whole of Pembrokeshire.

Rabbit on Skomer

The end of farming has also had a profound influence on the extent of bracken on the islands, a fern which would have been held in check by cultivation, cutting and trampling by cattle, and which has spread hugely on Skokholm and Skomer over the past 60 years. Aerial photography reveals that, on Skomer, it covered 40% of the island in 1947, 53% in 1969 and now occupies 73%. Combating this is a challenge for management of the islands, but experience shows that repeated cutting can check the spread. Such control might be especially welcome away from the seabird burrows, in the more recent farm fields of the islands where cropping for hay might be resumed, where there is the likelihood of competition with heather or in places where sub-surface archaeological remains are still undisturbed.

Telling the island story

More recent relationships between nature and culture on the islands, before and after the shift to conservation management, are not simply historical facts, but stories of people and place. Among the long parade of those who have made a home there, it is Ronald Lockley who has left the most enduring presence. He established Britain's first bird observatory on Skokholm in 1933 and wrote some of his 50 and more books there about his life and times in Pembrokeshire. His role there and on Skomer, his whole appreciation of island life, the memories of his awkward personality – these things ought to remain a key aspect of cherishing the culture and value of these places (see *Natur Cymru 2*, 2001).

The experience of staying on Skokholm is enriched by its distinctive and modest accommodation, its round of shared meals beneath the wrecked remains of the coal schooner 'Alice Williams', its fireside evenings with the nightly arrival of the shearwaters and petrels, and the general lack of signposts, interpretive boards and nature trails. Lockley's shadow adds to this. Care will be needed to maintain a balance between further development of facilities on this island, concern for health and safety, and the appealing simplicity.

All the surviving farmsteads on the islands retain strong associations with particular lives, and their anthropogenic flora, remnants of cultivation, little pleasure gardens and their more benign weeds deserve some celebration. The present house on Skokholm, for example, where Lockley lived, dates from 1760, and was built on the site of an earlier, perhaps rabbit warrener's, home. The Skomer Old Farm was built in the late 18th century, later largely rebuilt with ancillary buildings and more recently converted to self-catering accommodation for visitors. The farmhouse and associated buildings on Ramsey date from the early19th century; a water-powered corn-mill was added in the 1890s, and later a bungalow. The Trinity House connection provides another cultural asset with the Skokholm lighthouse, tramway track, gantry and jetty bearing testimony to the place of the islands as guide-posts on journeys.

Yn y canol, ar y cyrion

Er eu naws digyfnewid, mae ynysoedd ymhlith y llefydd mwyaf deinamig oherwydd effeithiau dyn a'r elfennau, a'r plethiad rhyngddynt. Bu dyn yn bresennol ers cyn co' ar ynysoedd Cymru, ond mae'r trawsnewid mwy diweddar o ffermio i gadwraeth natur wedi creu effeithiau amlwg, a chryn her. Newidiadau mewn pwysau pori oedd un o'r ffactorau pennaf ond mae presenoldeb cwningod wedi cymhlethu'r darlun. Ar ynys Sgomer, mae'r gweundir a ddatblygodd ar ben y clogwyni ar ôl i dda byw ddiflannu o'r ynys yn 1947 bellach wedi cilio eto, oherwydd effaith y cwningod. Ond cynyddu wnaeth y rhedyn ungoes yn absenoldeb da byw a gwaith aredig a thorri; yn 1947 gorchuddiai 40% o arwynebedd Ynys Sgomer ond heddiw mae'n tyfu dros 73% o'r ynys.

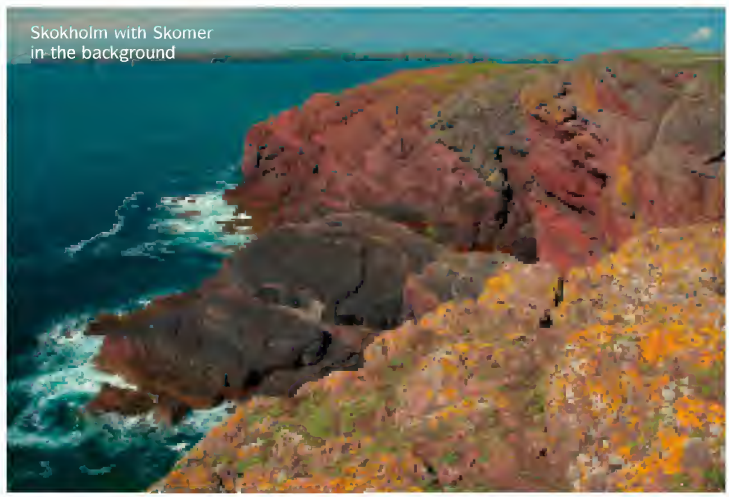
Yn wir, ni ellir datod dylanwad dyn a natur ar ein hynysoedd. Mae hanes a phrofiadau pobl yn rhan hanfodol o'u diwylliant a'u gwerth. Rhaid cadw cydbwysedd gofalus rhwng cynnal y naws unigryw a datblygu adnoddau pellach. Rhaid dathlu hefyd yr hen anheddau – eu cysylltiadau â bywydau unigolion a'u gerddi bychain sy'n tystio i fywydau pob dydd y gorffennol. Er gwychder eu bywyd gwyllt a'u tirwedd dramatig mae rhin ein hynysoedd yn tynnu ar eu hanes fel cartrefi i bobl, cyrchfannau i ymwelwyr a llwyfan lle gall enaid dynol sefyll ar ymyl y darlun mawr.

On the western seaway

For these Pembrokeshire islands lie along a cultural seaway that has been celebrated for centuries in trade links, monastic travel, stories and poetry. People as well as birds and marine life have journeyed as *peregrine*, as the ancient monks were called, along the western seaway. Crossing to the islands now, moving through the great waters "where sea shapes come in celebration", as the poet R.S. Thomas put it – this is an essential part of the experience of being there.

As the latest in a long line of humankind on the islands, we need to understand, evaluate and manage their wildlife resources in an integrated landscape-scale frame, learning to live with the changes there, gathering confidence and seizing moments to act – or going with the grain of nature. Much work has been done there and the records are rich in science and anecdote, with many reports, maps, letters and notes, though these archives need a thorough sort and cataloguing for us to get best benefit from our predecessors' experience. We have to remember too that, for those who have been before and will come after, Skomer, Skokholm and Ramsey are places, not simply sites. They take much of their splendour from their natural offshore setting, the dramatic terrain, the coastal vegetation and the seabirds, but part of their value lies in a sense of place that draws on their long history as homes for people, continuing destinations for visitors and settings which provide an opportunity for the human spirit to discover it can belong at the edge of the picture.

John Rodwell *was Professor of Plant Ecology at Lancaster University and now works as an independent ecologist. His report* From the Edge of the Picture*, where all this work is detailed and referenced, is available from the Countryside Council for Wales.*



Skokholm with Skomer in the background

Farming native plants of ancient pasture

Native plants provide a living link between the earliest farmers and the present. But the link is now tenuous, continues to be eroded by current farming methods, and sometimes only survives because of the passion of an individual for nature. One such farmer, ***RUTH WATKINS****, tells her farming story.*

CCW

Saw-wort, flourishing at the Pen y Graig Goch 'Orchid Wood'

In October 2000 I bought a 70 acre farm in the second year of organic conversion and the seventh year of Tir Cymen, the agri-environment scheme. It is at 600ft at the western end of the Brecon Beacons National Park on old red sandstone. It has a southerly aspect facing the Black Mountain across the valley through which the Sawdde Fechan flows, forming the longest border of my farm. Though the farm is optimistically called Pen y graig goch, head of the red rock, it is on a finger of glacial moraine that stretches west from the Carmarthenshire Vans. I learnt this when a large landslip with some of my oldest oak trees crashed into the Sawdde Fechan in the stormy wet December of 2000 leaving a 100ft high cliff of glacial till. The soil type is described as a surface water gley soil, a fine deep acid soil which drains poorly - a fact I muse upon as I splash across my fields after rain. I did not comprehend in 2000 how these features would profoundly affect the farming, the health of the grazing animals on the mineral poor soil and subsoil, and the farm's flora – the native plants of the semi-natural woodland and the unimproved fields, the ancient pasture.

Flowering rush

After spending most of my working life in London hospitals I wanted to practice nature conservation. The vital importance of traditional farming was only too clear to me, as during the time I grew up in Norfolk the hedges, trees, ponds or clay pits and ditches were all cleared away to make arable prairie. Modern agriculture gave the economic benefit of increased productivity. The cornfields full of red poppies and other wild flowers, the hedges full of yellowhammers, and the din of skylarks singing vanished. I did not

Michael Hammett/CCW

Silver washed fritillary

realize then that an agricultural revolution just as profound was being applied to pasture farmland too, one where modern seed, herbicides and mineral fertiliser cleared away the native plants and insects and other life of ancient pasture.

Native plants on my farm

A botanist from the Open University visited me in 2003 and we spent the day walking all over the farm. Other than the pasture of the dry fields which had been over-sown and 'improved' with white clover, there was only one place he noticed non-native plants immediately. I recalled that two years previously I had sown commercial organic grass seed, including a special woodland mix at great expense purchased from Cotswold Seeds to cover the new track made to access and repair the landslide. Though the plants had the same names as wild plants (fooling me), they were all cultivars or hybrids. The final repair to the river bank in 2005, to contain the erosion of the river's outward curve, created a scene of muddy devastation. I left it, as I have learnt from Flora locale. A variety of grasses, rushes and flowers such as black knapweed, an important nectar source in July and September, grew from the seedbank in the soil. It is now a lovely spot to watch butterflies and dragonflies such as the silver washed fritillary and the golden-ringed dragonfly.

Pen y graig goch is a typical traditional farm for this area both in size and composition. There are wet pastures including fen meadow and wet heath, dry pasture for hay, and mixed woodland (very wet) once coppiced for various uses including clogs from alder. There are mixed hedges and oaks on the raised field boundaries. The fields have existed for several hundred years but some boundaries have been removed to enlarge fields to about five acres. Neolithic and Bronze Age farming and settlement occurred above 1000ft and extensive remains are to be found on the Black Mountain, especially further up my valley where the soil is shallower and a well drained brown earth, better for sheep farming and out-wintering cattle, also for tilling and walking upon.

I believe there has been a continuity of the native wild plants on my farm not only in the woodland (there is small leaved lime by the river) but on the unimproved pastures even from Mesolithic times. Since then wild plants have had the opportunity to spread from open areas on the mountain, where the aurochsen and ponies grazed, to the newly cleared areas of the woodland valley in later millennia, which became pastures grazed by the introduced domestic cattle and sheep. This has allowed the wild plants to develop genetic diversity and adapt to local circumstances, evolving into a resilient and rich ecosystem. The diverse assemblages of native wild plants create infinitely varied pasture, especially where lime has been added: it has been extracted from the carboniferous limestone capping the Black Mountain since the Middle Ages. The ancient pastures have been maintained by selecting both the type of animal and the time of year to suit the wild flora, grazing in a regular pattern sustained for hundreds of years.

The grazing animals

I wished to farm the land myself but I could not do so without employing a local farmer to help as I had no previous experience of farming. This has enabled me to observe and control the grazing to permit the flowering and setting of seed on the unimproved pastures that allows the native wild plants to flourish and spread. I chose to get Welsh Black cattle and the local sheep, a small hefted flock I purchased at the farm sale.

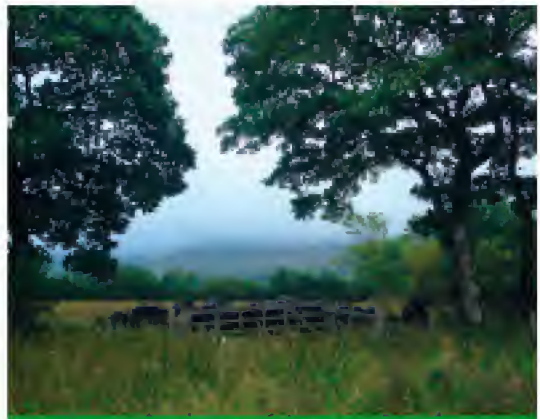
My Welsh Black cattle seem better adapted than the sheep, thriving better on my unimproved wet meadows than do the sheep on the mountain.

Domesticated cattle originated in the Near East from the wild local auroch. As the first farmers in the Neolithic period brought these cattle with them across Europe, the wild aurochsen bulls mated with these domesticated cows. The now extinct European aurochsen have contributed their Y chromosome and a significant proportion of the genome to modern indigenous cattle of north-west Europe. Perhaps this accounts for the ability of our native cattle breeds to thrive on our unimproved pasture, so different from the Near East. Modern farming has 'improved' breeds, selecting size and musculature, the double muscled gene in many modern breeds, so that they have lost the ability to thrive on unimproved pasture of native wild plants. They must be fed the modern hybrid and cultivar grasses and clovers in a mineral-fertilised sward to achieve supermarket size and financial return. The old unimproved pastures are of no value to the modern farmer.

The fen meadow and wet heath

A single line on the internet about the sale of Pen y graig goch, claiming it had an 'orchid wood', brought me to see it. No orchids were out in the autumn and I don't believe I could have recognised them anyway. The 'orchid wood' turned out to be a fen meadow and is a hauntingly beautiful place. It consists of mire vegetation. It is defined by the presence of meadow thistle and *Molinia*, or purple moor grass. It is waterlogged (70% water by weight in the soil in July) and there is much sphagnum moss. Many interesting plants are found there such as bog asphodel, lesser butterfly orchid, petty whin, saw wort, bog pimpernel and many sedges and rushes including two types of cotton grass. There is a succession of flowers from mid May to mid September. Also there is wet heath on soil, not peat, characterized by deer grass and cross-leaved heath, where heath milkwort and heath spotted orchids grow. Altogether the area comprises some 12 acres and about seven abandoned fields, with old oaks on the boundary mounds and boot-snatching wet alder and willow woodland encroaching onto the fields.

The birdsong during late May and June is a joyful racket of pied flycatchers, warblers, tits, finches and


Ruth Watkins

Before opening the gate - October 2nd

pipits. There are many more birds there than in the other woodland, perhaps because of the many insects in these old meadows, including the small pearl-bordered fritillary butterfly. The fen meadow is a well preserved fragment of the hundreds of acres once present in this part of south-west Wales near the sea, but it has now all but vanished.

These meadows must be grazed to keep them open as the plants of the fen and heath disappear in scrub or woodland. Cattle are the grazing animals needed. The tongues of cattle wrap around stems to tear them off. The cattle leave the basal rosettes of plants to re-grow and cannot graze down to the earth. They are not selective grazers except for the 4ft high angelica flowers in August. If not forced to graze too heavily, parts of flowering plants are left to seed and poisonous plants such as bog asphodel are largely spared. Cattle grazing creates a mosaic of vegetation heights from about 3cm to half a metre. The *Molinia* is grazed down and tussock formation is prevented. I vary the times of their grazing each year for a total of about 6 weeks from the beginning of June to the end of September and aim for roughly 50% of the *Molinia* to be removed. *Molinia* grassland looks white in aerial photographs in the winter, because it dies in October and only starts to re-grow in May; meadows with *Molinia* therefore need to be grazed in the summer.

Removing scrub

It has been necessary to remove scrub trees, up to

Cottongrass

Ruth Watkins

The wet heath

about 30 years old as estimated from their ring count. Both the small trees and brambles obstruct the cattle grazing so the *Molinia* becomes rank, shading out all the other plants before itself disappearing under the closed canopy. I found simple cutting of the scrub resulted in vigorous coppicing. I recorded the effect of cattle grazing on one fen meadow. There were hundreds of trees between 1 and 2 metres high after we had cut them down two years before; two thirds were alder and the rest ash, oak, birch, willow and mountain ash. A few alders had been slightly grazed by the Welsh Black cattle whilst no other species of tree escaped severe pruning. It is no surprise that surrounding woodland is predominantly alder.

The clearance of the four remaining floristically rich meadows has taken three years, wet weather permitting. The regeneration of the cut stumps is prevented by painting them with glyphosate, a biodegradable herbicide. Even so a few have sprouted and will need retreatment. The use of glyphosate has necessitated leaving the organic farming scheme which I did in 2005 in order to continue grazing this area whilst removing the scrub.

Graham Motley of CCW came to check the fen meadow and wet heath in 2003, ten years after he and Jamie Bevan had originally surveyed it. I was able to tag along and he remarked how even in ten years the scrub had encroached significantly. I was struck by his finding that all the plants originally

Mandy Marsh

Bog asphodel Ragged robin

present were still there 10 years later, and that such a complex ecosystem was so stable.

The unimproved wet meadows

I was also thrilled by the five wet meadows, said not to have been ploughed, with their succession of flowers all summer long and the large numbers of butterflies and day-flying moths such as the five-spot burnet moth. I had not known what to expect when I came, as the fields had been cut, grazed and trampled to nothing. Indeed I have observed that overgrazing is the condition of most similar meadows even in the Tir Gofal agri-environment scheme. One of the magic moments during the first summer, a hot dry one, was a haze of fine white umbellifers at the beginning of July. I discovered this was whorled caraway, locally common. The flowers include heath spotted orchids in June, greater bird's foot trefoil and black knapweed in July and fleabane, great burnet and devil's bit scabious in August. Amongst the tall rushes are marsh bedstraw and ragged robin. There are a number of hemi-parasitic plants, field lousewort, yellow rattle, red bartsia, eyebright and common cow-wheat. Each field is a little different from its neighbour. In one, devil's bit scabious has returned in a big way, appearing to spread colonially, as does meadow thistle. One field has broad ridges from an attempt long time past to create some drier ground and these are favoured by field lousewort, heath spotted orchid and heather. There are no agricultural weeds.

I had read the Tir Cymen agreement, which recommended excluding sheep from these fields completely, similar to the fen meadow and wet

heath. I grazed the cattle from mid July to the end of September for some three weeks on each of the wet meadow fields. The cattle thrive, putting on weight even in a hot dry summer, and the vegetation is deep and lush. In the winter they are put in the barn as all my fields are so wet they are susceptible to poaching. The over-wintering snipe love these fields.

Some local farmers were shocked by my management... "soft rush will claim the whole field" ..."how untidy" ...but the soft rush is no more extensive now than eight years ago. In fact there is least soft rush on the wettest areas, such as the fen meadow where the *Molinia* grows. The spread of *Molinia* in the wet meadows seems to be excluding the soft rush. I held some rams for a few weeks in June on one of the fields during extensive fencing of the sheep pasture. To thoroughly learn the effect of this sheep grazing I had a careful search afterwards. The grass seemed to be untouched but there was selective grazing of all the herb and sedge plants, nibbled to the ground. Soft rush is thickest on the wet meadows nearest the house where I expect a few sheep were conveniently put. Most of the native wild plants in the unimproved fields grow, flower and set seed but once in the year; hence they are especially vulnerable to grazing out by sheep, unlike the grasses and white clover of the dry sheep pasture which grow in spring, summer and autumn.

Conclusion

The great diversity of flowering plants was important to farmers past. It provided forage for their grazing animals (sheep were fewer and difficult to keep compared to cattle and ponies); nectar and pollen for bees; and was a source of herbal medicine for themselves and their animals, the only medicine until the 20th century. The Physicians of Myddfai originated from my parish. Their meadows are now a monoculture of matt grass created by sheep grazing on the neighbouring Myddfai mountain; and their well is enclosed by Forestry Commission conifers. The County Botanic Recorder says the unimproved fields, the fen and wet meadows and wet heath at Pen y graig goch are some of the finest in Carmarthenshire. At least 95% of all similar meadows have been lost to modern agriculture and sheep grazing. It is luck that those at my farm survive. The old farmers who chose not to modernise their farms since the 2nd World War are the heroes of conservation. I expect that this great loss will be reflected in all the species that depend on them. I have searched the verges on the nearby lanes and there is no reservoir there for the plants in my meadows. To conserve ancient meadows and enable them to flourish, farming should put the native wild flora first.

Ruth Watkins *is a retired doctor of medicine and clinical virologist. Anyone who would like to see the wildlife on her farm is warmly welcomed. She can be contacted by email at* ***ruthwatkins@supanet.com***

Seed can be collected by hand for those with a suitable site to restore – please also contact Ivy Berkshire of Flora Locale ***wildmeadows.ivy@googlemail.com***

Gwerddon yn Sir Gâr

Ar lan y Sawdde Fechan, ym mhen gorllewinol Parc Cenedlaethol Bannau Brycheiniog, mae bywyd gwyllt yn cael cyfle i ffynnu ar fferm fach 70 erw a hynny oherwydd brwdfrydedd a rheolaeth ofalus yr awdur. Mae fferm Pen-y-Graig Goch yn un draddodiadol ond anghyffredin erbyn hyn; mae'n cynnwys cymysgedd o ddolydd gwlyb a chaeau pori sych, rhywfaint o rostir a choetir a hen derfynau caeau gyda gwrychoedd cymysg a choed deri hynafol. Ymhlith trysorau pennaf y fferm mae ardal o ddôl ffen sy'n llawn planhigion hyfryd fel cracheithin, llafn y bladur a thegeirian llydanwyrdd bach ac sy'n ferw o gân adar a sŵn sio trychfilod yn yr haf. Mae rheoli'r prysgwydd yn dipyn o her yn yr hen gaeau hyn, ac oherwydd yr angen i drin y llwyni â chemegolyn bu'n rhaid gadael y cynllun organaidd rai blynyddoedd yn ôl. Ardal arall wych yw'r caeau gwlyb, sydd bellach yn cynnal planhigion fel y garwy droellennog, robin garpiog, y bwrned mawr a thamaid y cythraul ar ôl gostwng y pwysau pori ar y tir. Gyda chymorth gwartheg duon Cymreig, yn fwy na dim arall, mae'r tir nawr yn cael ei reoli ar gyfer bywyd gwyllt yn bennaf ac mae hen gaeau a dolydd Pen-y-Graig Goch ymhlith y gorau yn Sir Gâr.

Jude Lane

Bwrlwm gwaith ar gorstiroedd Cymru

Rhwng Nant y Galen a Nant Sebon

Yn rhifyn Gaeaf 2007 y cyfeiriwyd gyntaf yn Natur Cymru at brosiect LIFE ar fynyddoedd y Berwyn a'r Migneint – prosiect sy'n ceisio adfer cyflwr y cynefin gorgors ar yr ucheldiroedd hyn. Mae'r prosiect wedi bod ar y gweill ers tair blynedd bellach, rydym yn carlamu tuag at gyflawni'r targedau. O'r ymdrechion ymarferol i adfer cynefin i weithio gyda'r gymuned leol, mae'r prosiect yn helpu lledaenu'r neges am bwysigrwydd y cynefin prin hwn. ***MICHAEL MORRIS,*** *Swyddog ymgynghorol LIFE a warden y Migneint ar ran yr RSPB, sy'n sôn am y cynnydd a wnaed hyd yma.*

Mae gorgors yn un o'r cynefinoedd prinnaf yn y byd. Yng Nghymru rydym yn hynod o ffodus bod ardaloedd sylweddol o orgors yn dal i fodoli, ac mae'r rhain yn effeithio'n fawr ar yr amgylchedd sy'n ein cynnal. Mae'r cynefin yn gartref i blanhigion, pryfed ac adar anghyffredin, yn cynnig tir pori hollbwysig ar gyfer ffermydd yr ucheldir ond mae hefyd yn ffynhonnell allweddol o ddŵr yfed ac yn storfa enfawr o carbon sydd wedi datblygu'n radddol dros filoedd o flynyddoedd. Mae pwysigrwydd gorgorsydd ar gyfer dyn, yn ogystal â byd natur, yn ei gwneud hi'n angenrheidiol i weithredu'n gynt o lawer er mwyn gwarchod y cynefin rhag newidiadau hinsawdd yn y dyfodol.

Tiroedd gwlyb a mawnog sydd ond yn derbyn dŵr ar ffurf dyddodiad (glaw, eira, cymylau, niwl) yw gorgorsydd. Dosbarthiad cyfyngedig iawn sydd ganddynt drwy'r byd, a dim ond mewn gwledydd gyda dyddodiad uchel a thymheredd cymharol isel y gwelir y cynefin. Mae Cymru yn sicr yn un o'r gwledydd hyn!

Pridd llawn dŵr sy'n cynnwys deunydd llysieuol wedi ei gywasgu ac sydd wedi rhannol bydru yw mawn. Mae'r mawn yn ffurfio pan fydd planhigion nodweddiadol, yn enwedig migwyn (*Sphagnum spp.*), yn gwywo ond yn

methu pydru'n llwyr oherwydd bod cymaint o ddŵr ac asidedd yn bresennol. Yn raddol caiff y planhigion hyn eu hymgorffori yn y mawn sy'n cynyddu ar gyfradd o ryw 1mm y flwyddyn.

Yma yng Nghymru mae ein gorgorsydd yn gynefinoedd hen iawn ac mae'r mawn yn fwy na 5m o ddyfnder. Ymhlith y planhigion nodweddiadol a welir yno mae migwyn (*Sphagnum spp.*), grug, grug croesddail *Erica tetralix*, glaswellt y ceirw Trichophorum cespitosum, a phlu'r gweunydd (*Eriophorum spp*). Mae gorgorsydd hefyd yn gynefin pwysig i amrywiaeth o greaduriaid bendigedig, yn cynnwys nifer fawr o drychfilod fel y picellwr pedwarnod Libellula *quadrimaculata*.

Rydym yn lwcus yng Nghymru bod gennym ardaloedd mor helaeth o'r tirlun godidog a rhyfeddol hwn ar garreg ein drws. Mae tua 12-15% o orgors y byd o fewn y Deyrnas Unedig ac mae rhyw 70,000 hectar (dros 170,000 acer) o'r arwynebedd hwn yma yng Nghymru. Yn anffodus mae cyfran helaeth o orgorsydd Cymru mewn cyflwr gwael a hynny'n bennaf oherwydd effaith dyn ar yr amgylchedd.

Mae'r prosiect LIFE yn canolbwyntio ar ddwy o'r ardaloedd mwyaf o orgors yng Nghymru, sef Ardal Cadwraeth Arbennig (ACA) Mynyddoedd Berwyn a De Clwyd ac ACA Migneint-Arenig-Dduallt yng nghanolbarth Cymru. Rhain hefyd yw'r ddwy ardal fwyaf o orgors sy'n dal i fod mewn cyflwr gweddol dda. Ond mae'r safleoedd hyn hefyd dan fygythiad parhaus oherwydd presenoldeb dyn ac os na wnawn ni weithredu nawr mae'n bosib y gallem golli'r cynefin gwych hwn. Wrth gwrs, nid yw popeth y mae dyn yn ei wneud yn niweidiol. Fel hwsmoniaid, mae llawer o ffermwyr a rheolwyr tir yn gweithio er lles eu hanifeiliaid a'r amgylchedd sy'n eu cynnal.

Er mwyn datblygu ymhellach yr awydd sydd gan nifer o ffermwyr i ofalu am y dirwedd y maen nhw'n ei gwerthfawrogi cymaint mae Prosiect LIFE yn gwahodd ffermwyr a tirfeddianwyr o fewn ardal y prosiect i ymweld â Gwarchodfa RSPB Cymru yn Llyn Efyrnwy; yma gallant weld a thrafod y gwaith adfer cynefin sy'n digwydd ar y tir. Rydym yn arbennig o awyddus i drafod y gwaith cau ffosydd a hefyd y manteision y gallai'r gwaith rheolaeth gwahanol hwn greu o safbwynt dyfodol ffermydd mynydd, lleihau colledion stoc, cyflwr bywyd gwyllt, ansawdd dŵr a storio carbon.

Fiona Walker

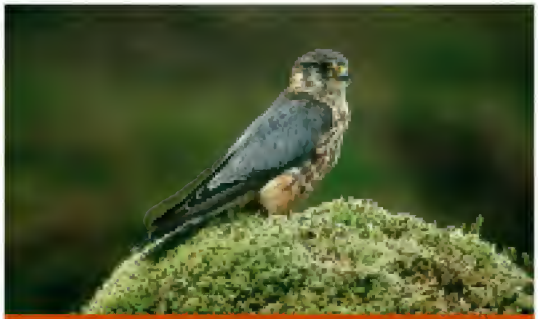
Migwyn *Sphagnum*

Gwaith ymarferol

Yn ystod y tri gaeaf diwethaf rydym wedi cau mwy na 60km (37 milltir) o ffosydd o fewn yr ardal o orgors ar Warchodfa Llyn Efyrnwy RSPB Cymru. Mae'r gwaith yma wedi golygu gosod dros 10,000 o argaeau mawn a byrnau grug. Nid o amgylch Llyn Efyrnwy yn unig y mae'r gwaith hwn yn digwydd; mae dros 130km (81 milltir) o ffosydd a grewyd er mwyn plannu coed hefyd wedi cael eu cau ar dir Comisiwn Coedwigaeth Cymru ym Mhenaran, ger y Bala. Yn ogystal â hyn mae dros 1600 hectar (3950 acer) o orgors wedi'u hadfer drwy glirio fforest gonwydd a thynnu coed Sbriws Sitca a llwyni Rhododendron sydd wedi hunan-hadu.

Gyda dau gaeaf arall i fynd mae'r prosiect yn disgwyl cau'r holl ffosydd o amgylch Llyn Efyrnwy. Rydym hefyd yn gobeithio y bydd y prosiect yn llwyddo sicrhau bod draeniau'n cael eu cau ar diroedd eraill, os yw'r perchnogion a'r deiliaid tir yn fodlon i hyn ddigwydd.

RSPB



Cudyll bach

Drwy wahodd yr holl ffermwyr, tirfeddianwyr a rheolwyr tir o fewn ardaloedd y prosiect i weld a thrafod y gwaith cau ffosydd ar y warchodfa mae'n gyfle nid yn unig iddynt weld y gwaith yn uniongyrchol, ond yn gyfle hefyd i ni gael adborth ychwanegol ac i ddysgu mwy am farn y gymuned amaethyddol wrth i'r gwaith fynd yn ei flaen. Hyd yn hyn, mae'r adborth wedi bod yn galonogol iawn; bwriedir cynnal diwrnod agored ym mis Mehefin 2009 i arddangos y gwaith er mwyn denu rhagor eto o ffermwyr a tirfeddianwyr.

Cymuned

Dim ond un elfen o brosiect LIFE yw'r gwaith rheolaeth ar y cynefin bregus hwn. Os am warchod gorgors ar gyfer cenedlaethau'r dyfodol mae'n hanfodol addysgu pob aelod o'n cymdeithas am bwysigrwydd y cynefin. Os na lwyddwn ni ddysgu'n plant a'n hoedolion ynglŷn â rhyfeddod a phwysigrwydd gorgorsydd mae'n bosib mai'r genhedlaeth bresennol fydd yr olaf i weld eu gogoniant. Trwy newid y ffordd y mae pobl yn meddwl am gorsydd mae siawns y gallwn helpu diogelu'r cynefin hwn at y dyfodol.

Felly, yn ogystal â bwrw 'mlaen gyda'r elfennau ymarferol o'r prosiect mae'r tîm yn ceisio cysylltu a phontio gyda chynulleidfa fawr ac amrywiol. Dros y ddwy flynedd ddiwethaf trefnwyd 36 taith dywys ar gyfer y cyhoedd a grwpiau preifat. Mae'r teithiau yma wedi denu dros 460 o bobl o'r gymuned leol, a hefyd o lefydd pellach i ffwrdd, i ddod i weld yr orgors a'r gwaith adfer ar Warchodfa Llyn Efyrnwy RSPB Cymru. Mae'r math yma o ddigwyddiad yn helpu codi ymwybyddiaeth am y math o weithgaredd sy'n digwydd ar rostiroedd Llyn Efyrnwy ac ar ucheldiroedd eraill. Mae hefyd yn ffordd o gynyddu

(only English caption supplied)

Dinsdale Moorland Services

dealltwriaeth pobl am y cynefin prydferth hwn a'i rywogaethau – a'r rhan y mae wedi chwarae yn ein hanes fel pobl.

Mae staff y prosiect hefyd wedi cyflwyno sgyrsiau i 21 grŵp o fewn y gymuned leol, o Gymdeithas y Cerddwyr i Glybiau Garddio a grŵp Age Concern. Mae'r grwpiau hyn wedi amrywio'n fawr o ran oedran yr aelodau a'u gwybodaeth am orgorsydd. O ganlyniad i'r sgyrsiau hyn mae dros 370 o bobl wedi dod i wybod mwy am orgorsydd ac am y prosiect ei hun.

Eisteddfod 2009

Eleni rydym yn cynllunio nifer o weithgareddau i godi ymwybyddiaeth am gynefin gorgors. Mae'r Eisteddfod Genedlaethol yn cael ei chynnal yn y Bala rhwng 1-8fed Awst 2009, yng nghanol ardal y prosiect. Mae'r Bala'n gorwedd rhwng ACA Mynyddoedd Berwyn a De Clwyd ac ACA Migneint-Arenig-Ddu allt ac mae'r Eisteddfod Cenedlaethol eleni, felly, yn gyfle delfrydol i ledaenu'r neges am brosiect LIFE Gorgors Fyw, ac i geisio cyffroi pobl am yr amgylchedd naturiol sydd o'u cwmpas.

Trwy gynllun nawdd 'Natur ein Bro', a drefnir gan Gyngor Cefn Gwlad Cymru a'r Eisteddfod Genedlaethol, fe fydd ysgolion cynradd yn cael ymweld â gorgors Llyn Efyrnwy, ble byddant yn dysgu am y cynefin trawiadol hwn, a'i gyfraniad at eu

diwylliant ac at hanes eu cyndeidiau. Ar sail yr ymweliadau hyn bydd y plant yn cyfleu eu hargraffiadau am y gors mewn gweithdai llenyddol, gan weithio gyda bardd adnabyddus yn eu hysgolion lleol. Fe fydd rhai o'r plant yn darllen eu gwaith yn y Babell Lên yn ystod wythnos yr Eisteddfod. Dyma gyfle gwych i gysylltu nifer o blant lleol, a'u teuluoedd, gyda'r amgylchedd sy'n rhan mor allweddol o'u treftadaeth. Y nod, drwy ddysgu'r plant am eu gorffennol a'u cysylltiad gyda'r amgylchedd, yw ceisio annog cenhedlaeth newydd i ofalu am fywyd gwyllt ac yn arbennig am orgorsydd.

Nid yw'r cyfan ar gyfer plant! Bydd y prosiect yn annog grŵpiau celf lleol i greu darnau o waith ar gyfer yr Eisteddfod hefyd. Bwriedir cysylltu â chymdeithasau celf a chlybiau ffotograffig gyda'r syniad o greu arddangosfa yn seiliedig ar orgors ucheldir Cymru. Os oes gennych ddawn gelfyddydol neu awydd i gynhyrchu rhywbeth i'w arddangos ar stondin y prosiect, gafaelwch yn eich brws neu'ch camera ac ewch allan i'r mynyddoedd!

Trwy gydol wythnos yr Eisteddfod, fe fydd y prosiect yn cynnig teithiau tywysedig ar y gors i gymaint o bobl â phosib - gyda rhai yn dechrau o Lyn Efyrnwy, ac eraill yn ardal Bala. Trwy gyfrwng y teithiau hyn, a'r digwyddiadau ar y stondin, mae cyfle arbennig i ddangos i gynulleidfa 'Steddfodol bod gorgors Cymru yn rhan bwysig o'n gorffennol a'n dyfodol.

Y dyfodol?

Amcan Project LIFE Gorgors Fyw Cymru yw sicrhau gwelliant pwysig, sylweddol a pharhaol yng nghyflwr gorgorsydd ar Fynyddoedd Berwyn a De Clwyd ac o fewn Ardal Cadwraeth Arbennig Migneint-Arenig-Dduallt. Er mwyn cyflawni hyn mae angen gwneud llawer iawn o waith adfer dros ganolbarth Cymru, ac er pwysiced yw'r gwaith sy'n digwydd nawr mae'n hanfodol ei fod yn parhau yn y dyfodol. Trwy bontio gyda'r cyhoedd a rhannu gwybodaeth gyda hwy drwy gyfrwng teithiau a sgyrsiau, a thrwy fynychu digwyddiadau fel Steddfod Bala 2009, gobeithiwn adael gwaddol a fydd yn helpu gwarchod y cynefin hudol a hanfodol hwn ar gyfer cenedlaethau i ddod.

*Mae **Mike Morris** yn gweithio i'r RSPB fel Swyddog Ymgynghorol LIFE a Warden Migneint yn Llyn Efyrnwy, Powys.*

Mae Prosiect LIFE Gorgors Fyw yng Nghymru yn brosiect pum mlynedd sy'n anelu at adfer ardaloedd helaeth o orgors yng Nghymru i gyflwr ffafriol. Mae'n bartneriaeth rhwng yr RPSB, Comisiwn Coedwigaeth Cymru, Cyngor Cefn Gwlad Cymru ac Asiantaeth yr Amgylchedd (Cymru). Daw 75% o gyllideb £275m y prosiect o raglen LIFENature yr Undeb Ewropeaidd. Os am ragor o wybodaeth am y prosiect cysylltwch gyda'r tîm drwy gyfrwng y wefan, sef **www.gorgorscymru.org**

(only English captions supplied)

Credit not specified

Breathing LIFE into bogs

Three years into the LIFE Active Blanket Bog in Wales Project, and work is progressing well. On the practical habitat restoration front more than 60km of drainage grips have been blocked on the RSPB Cymru Lake Vyrnwy Reserve, involving the installation of over 10,000 heather bale and peat dams. An additional 130km of forest planting ditches have been blocked on Forestry Commission land near Bala and 1600 hectares of blanket bog have been restored by the removal of plantation forestry and self-seeding spruce and Rhododendron bushes. But the project isn't all about practical management and restoration. Sharing experience and knowledge and inspiring others about the beauty and value of blanket bog habitat is equally important and the project team have been busy organising events and leading walks for a host of local groups as well as for visitors. Local farmers have also been invited to see and discuss the work on the Vyrnwy reserve and the response has been encouraging. This year's National Eisteddfod at Bala will provide an additional and exciting opportunity to connect children and adults alike with the blanket bogs of the Berwyn and Migneint-Arenig-Dduallt uplands.

All images: Richard Birch

Life, but not as we know it...
Tracking trilobites

Above: Figure 6, *parabolina spinulosa*

The time-travelling Doctor (Dr Who?) has become associated with Wales, where the programmes are made, and Wales has become known to geologists around the world for another form of time travel, the study of geology. Here a naturalist becomes part of the script, as RICHARD BIRCH uncovers the trail left by a vanished life-form, the trilobites.

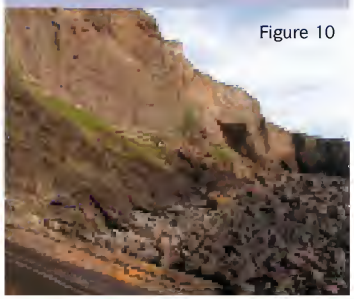


Figure 10

Ancient life is often considered the preserve of the palaeontologist – a different animal from the birdwatcher, the botanist or the marine biologist, being more closely affiliated with geology. Although the palaeontological subject is inanimate and dead, it was once a living creature. Piecing together the behaviour of an extinct animal, from the fossil evidence it left behind after it died, employs the same disciplines as walking along the tideline and working out when the dogfish laid their eggs, or what wading birds were feeding in the mud an hour ago.

The significance of Wales in the geological history of the Earth

Wales plays a significant part in the classification of geological time, and many of the subdivisions of the palaeozoic epoch – basically, life *before* the dinosaurs – are named after places in Wales. British geologists mapping the palaeozoic in the early 19th century were inspired by Welsh names, so the first three major epochs, the Cambrian, Ordovician and Silurian, were derived from the names of Welsh mountains or tribes. Even the sub-divisions of this classification system often owe their names to the Welsh localities where they were first identified. For example, the Ordovician has five major sub-divisions (Tremadoc, Arenig, Llanvirn, Caradoc & Ashgill) of which the first three are places in Wales. This is an international classification: rocks that represent the boundary between the late Cambrian and the early Ordovician are Tremadoc rocks whether they occur actually in Tremadog, or in a remote valley in China.

Evidence of the earliest life

Some of the oldest sedimentary rocks in north Wales occur on the west coast of Anglesey. Blue-grey limestones on the coast at Llanbadrig are considered to be late Precambrian; at least 575 million years old. There are no obvious fossils in them, but occasionally one can see columnar and rounded structures (Figure 1). These are *stromatolites*. They are formed from the deposition of calcium by microscopic blue-green algae, which lived in shallow water around the edge of a lagoon. They can still be found today in similar inhospitable habitats, such as Shark Bay in Northwest Australia (Figure 2), where daytime temperatures exceed 40°C and evaporation exceeds deposition, so that the water is practically brine. Such places offer a revealing insight into how the Precambrian landscape of Wales may have looked.

The Cambrian detective

Among the folds of Snowdonia's igneous rocks there are sedimentary zones providing windows into a Cambrian sea. At Cwm Graianog, east of Bethesda quarry in Gwynedd, strange patterns can be seen on the rocks littering the floor of the cwm. These patterns are vaguely familiar to anyone who has walked across the mud at nearby Red Wharf Bay or the Fforyd: they look like the tracks and burrows of marine organisms. Some of the comparisons can be made directly: on the west face of the cwm the apparent tidal ripple marks on the cliff face are exactly that; the marks in the rock that look like worm burrows are worm burrows. These are called *trace fossils* (Figure 3): the fossilised *behaviour* of life, rather than life itself. But there are also some long linear marks in the rock that look like pleated rope. What do they belong to? A crab? Some kind of snail?

The answer can be worked out by an extraordinary piece of detective work. The first point to make is that the rocks can be confirmed as Cambrian because the finer mudstones in the cwm occasionally contain the shells of a primitive brachiopod called *Lingullela davisi* (Figure 4). Brachiopods were bivalves similar in appearance to an oyster, but with a fleshy rod protruding from the base of the shell, with which they attached themselves to the

Figure 2 Figure 4

substrate. This can be seen as a small hole, and in some examples made the shell look like a traditional oil lamp, hence the common name of 'lamp shell'. Lingulid brachiopods can still be found today in the Pacific, typically in estuarine environments, and are still harvested for food in Japan, but this particular species is indicative of the late Cambrian, so it acts as a geological clocking-in card: wherever it occurs crowded on the bedding planes of the hard flagstone, it provides an indicator of the late Cambrian. However, it is so similar to the modern day forms that it is probably safe to assume it lived in similar conditions.

Having identified the age of the rocks, and the environment in which they were formed, it is possible to narrow the search parameters to identify the tracks, known as *Crusziana*, in the rock. The Cambrian contained no fish, no crabs, and not many gastropods, starfish or sea urchins. It did contain curious arthropods called *trilobites*: marine creatures that looked a bit like woodlice. In fact, they were the dominant life form in the Cambrian. Could they be the creatures responsible for the pleated tracks in the rocks at Cwm Graianog, and if so, where are their remains?

If the Graianog rock is examined closely, it will be seen to be fairly coarse sandstone, indicative of a turbulent shallow-water environment, perhaps similar to the beach at Newborough, on Anglesey. If this comparison is pursued, then it is possible to walk a long way on the beach at Newborough and see very little direct evidence of life. Shells and seaweed are all cast up into a narrow strandline; the rest of the beach is apparently sterile, although if the tide hasn't wiped it clean it may contain worm

Figure 5

Figure 7

Figure 8

Figure 12

cast and tracks. So perhaps the ancient beach at Cwm Graianog, preserved as a snapshot in all its detail, may have looked like Newborough (and somewhere inside the mountain, there is a fossil strandline with the shells of the creatures that lived there).

Without those remains, some of the tracks in the Graianog sandstone are enigmatic and puzzling.

It was the trilobite wot done it

There may be no trilobite remains at Cwm Graianog but further south, near Trawsfynydd, rocks of similar age were laid down in muddier conditions, probably in deeper water. We know they're the same age, because *Lingullela davisi* can be found there too. There were no currents to disseminate the remains: an animal lay where it fell until the muddy sediments buried and entombed it. Millions of years later, those sediments, turned to rock, are exposed by the course of a river, or by the construction of a road, and the creatures in them are revealed, often in exquisite detail. At last we can get a good look at a Cambrian trilobite (Figures 5-6).

They might look like woodlice, but they got that way from a different evolutionary starting point, and any similarity is purely coincidental. Their internal organisation was radical: for example, the eggs were probably incubated in the swollen lobe on the head (called the *glabella*) as in modern Horseshoe crabs (*Limulus polyphemus*), their closest living relative. Legs aren't preserved, even in the fine mudstones on the west flanks of Arenig Fawr. What can be seen in a typical trilobite fossil is only the carapace, because the limbs were not encased in the same material. In effect, the animal was soft-bodied, and wore its shell like a tortoise.

Without evidence of legs, it isn't possible to directly match the fossil trilobites with the Cwm Graianog tracks. On the other hand, we can dismiss a lot of creatures that weren't around at the time to make the tracks, so the behaviour of trilobites can be predicted from them. The rope-like *Cruziana* follow a pattern: the organism adopted a systematic approach, following wide loops to avoid repeatedly retracing its own footsteps (Figure 7). A feeding animal sifting through the detritus on the modern sea floor would adopt similar strategies to avoid sampling the same sand twice, so Cruziana look like feeding trails. Periodically, there are strange, heart-shaped marks, sometimes associated with the *Cruziana* tracks. In the best preserved cases, these heart-shaped marks (called *Rusophycus*) look almost like fossil trilobites (Figure 8), adding weight to the theory that trilobites caused them. If so, then the animal must have buried itself in the mud at this point, pushing the sediment outwards and over its back, as modern-day crabs do.

So far, there is no direct proof for any of this: a critic might counter by saying that none of the trilobites from the sediments at Trawsfynydd are the right size, but there are trilobites from rocks at Penrhyndeudraeth that more closely match the size of the Cwm Graianog tracks (Figure 9).

Ordovician life on the Llŷn peninsula

If further evidence is needed, then fast-forward 75 million years to Trywyn Llech-y-doll on the Llŷn peninsula (Figure 10). The rocks here contain similar tracks. They're smaller and less well defined, but they appear to follow the same patterns as at Cwm Graianog (Figure 11). The difference is that these rocks are Ordovician, not Cambrian.

Trilobites were still the major life form in the Ordovician, and they had diversified into many bizarre forms occupying every niche. Near Llanbedrog, Ordovician mudstones contain a hugely varied line-up of prime suspects (Figure 12-14). If there is still doubt, then observations from around the world confirm that *Cruziana* and *Rusophycus* are the tracks of trilobites. Whole specimens at the end of *Cruziana* trails have been found in America, and there are quite amazing *Rusophycus* from Australia,

Figure 13

Figure 14

with every segment and leg movement picked out by the fine sediments that filled the burrow afterwards.

Trilobites became extinct during the cataclysmic extinction in the Permian, 290 million years ago. They left no descendants, and they are as alien to the world of today as if they had come from another planet. Yet at Cwm Graianog and Trywyn llech-y-doll, trace fossils offer an extraordinary insight into the life of these creatures and the period in which they lived; a period which enshrines Wales in the language of the geology for the whole world.

***Richard Birch** is an ecologist with Capita Symonds consultancy.*

Y ditectif daeareg

Mae Cymru'n le gwych i wneud gwaith ditectif ar y creigiau hynafol hynny a fedyddiwyd gydag enwau Cymreig gan ddaearegwyr y 19egG – y creigiau Cambriaidd, Ordoficaidd a Silwraidd.

Presenoldeb y braciopod cyntefig *Lingulella davissii* sy'n nodweddu creigiau gwaddodol y cyfnod Cambriaidd. Gwelir eu cregyn yn chwarel Cwm Graianog ym Methesda; cawsant eu cloi o fewn y gwaddodion pan oedd yr ardal hon yn fôr bas filyniau o flynyddoedd yn ôl. Ond mae patrymau eraill hefyd yng nghreigiau Cwm Graianog – tebyg i raff wedi plethu. Olion gweithgaredd creaduriaid yw'r rhain, nid y creaduriaid eu hunain. Rhaid chwilio mewn mannau eraill, yng Nghymru a thrwy'r byd, i gael gwybod beth ffurfiodd y rhain. Ai'r trilobitau a welir yng nghreigiau Cambriaidd Trawsfynydd efallai? Y creaduriaid croen meddal hynny a wisgai gragen sy'n edrych fel gwrachen ludw mewn ffosiliau – ac un o'r prif greaduriaid morol yn cyfnod Cambriaidd? Nid yw trilobitau Trawsfynydd yn faint cywir i fod wedi creu olion Cwm Graianog, er bod rhai tebycach yng nghreigiau Penrhyndeudraeth.

Gwelir patrymau tebyg i rai Cwm Graianog mewn creigiau iau Ordoficaidd ar Drwyn Llech y Doll ym Mhen Llŷn. Roedd trilobitau yn dal i fod yn greaduriaid morol pwysig yn y cyfnod hwn ac roeddent wedi esblygu'n amrywiaeth ryfeddol o ffurfiau. Dim ond olion eto sydd yma, ond mae tystiolaeth o leoedd eraill drwy'r byd yn profi mai traciau trilobitau yw *Cruziana*. Diflannodd trilobitau'n llwyr yn y cyfnod Permiaidd, 290 miliwn o flynyddoedd yn ôl. Ond mae olion ffosil Cwm Graianog a Thrwyn Llech y Doll yn cynnig cip ar eu bywydau rhyfeddol a'r cyfnod sydd wedi rhoi lle blaenllaw i Gymru fel rhan o iaith ddaearegol y byd.

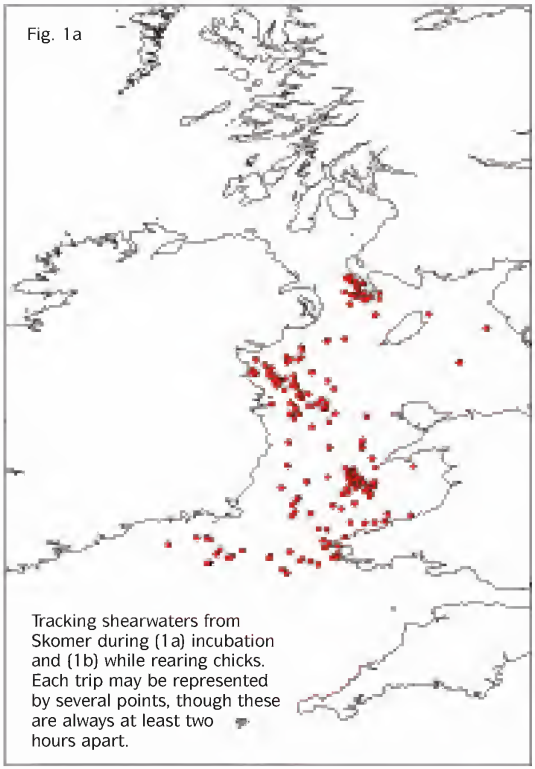
Tracking the movements of **Manx shearwaters at sea**

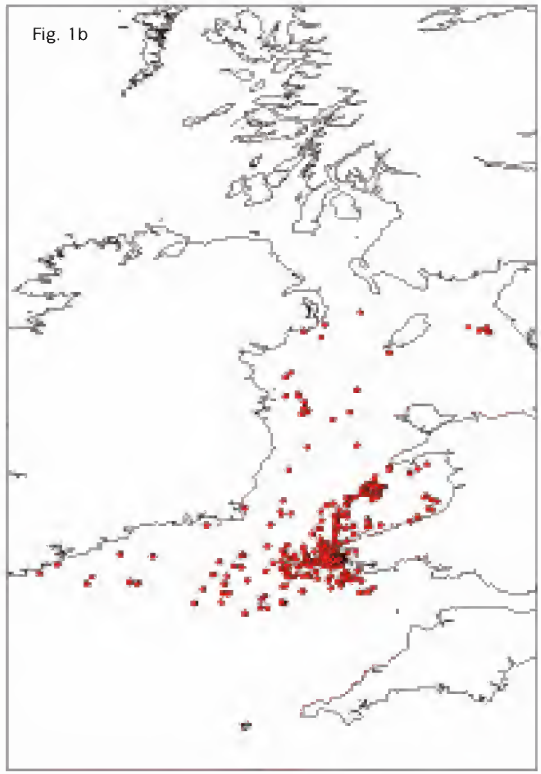
Mike Alexander

Manx shearwaters undertake huge journeys, are long-lived and come ashore in the dark. Their mysterious lives lend them undeniable charisma. Wales is home to a large proportion of the world's breeding population; efforts to secure their conservation, notably through a better understanding of what they depend on when at sea, are being pioneered here, as ***CHRIS PERRINS*** *reports.*

The Manx shearwater *Puffinus puffinus* is arguably the most British of all our birds. This is because perhaps as much as 90% of the world population breeds in Britain and Ireland; a level not exceeded by any other species. The world total is of the order of 0.35 to 0.4 million pairs and of this, some 160,000 pairs – almost half – breed in Wales (figures based on Newton et al 2004).

Hence the UK has a special responsibility for this species. This responsibility is increased because the birds breed in very few sites, being almost exclusively restricted to rat-free islands. In the case of Wales the main islands are Skomer (101,000), Skokholm (46,000) and





Tracking shearwaters from Skomer during (1a) incubation and (1b) while rearing chicks. Each trip may be represented by several points, though these are always at least two hours apart.

Middleholm (3,000) in Pembrokeshire together with Bardsey (16,000) in Gwynedd (Smith et al 2001, Newton et al 2004). Hopefully the population on Ramsey, where there are perhaps more than 1,000 pairs, will show a rapid increase, now that the island has been cleared of rats.

In order to flourish, seabirds have two basic requirements: safe nesting sites and areas in which to find plentiful food, especially while they are feeding young. In the case of the Welsh Manx shearwaters, the nesting sites are relatively safe, being mostly wardened nature reserves where the arrival of rats would be rapidly spotted and where action plans to deal with their arrival are in place. One cannot be so sanguine about the feeding areas for the birds – if only because we still do not know where they are!

Studies

Our knowledge of the biology of Manx shearwaters is strongly Welsh-based. Studies started in the 1920s with the pioneer work of Ronald Lockley who produced his now classic book (Lockley 1942). After the second World War, studies were started again in earnest by Mike Harris, Tony Diamond and myself (Perrins et al 1973) and later again by Mike Brooke who wrote a second book on them (Brooke 1990). We learned a considerable amount about the birds, but all these studies were limited to what could be observed at the nesting colony, a serious limitation for a pelagic seabird.

One attempt to overcome the limitations of land-based studies was made by the JNCC "Seabirds at Sea" team. They made large numbers of cross-sea transects counting seabirds and looking for areas where there were feeding concentrations (eg. Pollock et al 1997, Stone et al 1994). These provided valuable information about where the different species were to be seen at sea. But, again, there were limitations: they could not tell which breeding colonies the birds were coming from and non-breeders – which are numerous in long-lived

species such as the Manx shearwater – were not necessarily coming from a colony at all.

Tracking studies

Recent advances in technology have started to revolutionise the study of seabirds away from their breeding sites. The early tracking devices sent signals back via satellite; these were relatively large and so could only be used on large birds such as albatrosses and eagles. The size of these tracking devices has been coming down rapidly, but in addition there are now even smaller trackers which require the bird to be recaptured in order to remove the device with its stored data. Here we report on two studies, using such devices, which we have made recently on Manx shearwaters on Skomer Island.

GPS loggers

We have used GPS loggers to track birds during the breeding season (Guilford et al 2008). These weigh up to about 16g (c 4% of bodyweight) and are taped to the back feathers. The birds only carry them for one trip out to sea, after which they are removed. This may be as much as 8-9 days during incubation, but is usually no more than two days when they are feeding young. In the case of foraging trips during incubation (which last about a week), the first GPS devices did not have sufficient battery power to track complete foraging trips. Nevertheless, in many cases birds appear to have reached a foraging destination by the time the battery ran out. The devices recorded the birds' positions every two hours to an accuracy of just a few metres.

The tracks (fig 1) show where the birds go. Although they are well spread around the Irish Sea, there is a strong tendency for the birds to concentrate in three areas and these largely match those reported by Begg & Reid (1997). This is somewhat surprising since the

(caption)

Skokholm and Skomer birds were thought to head south towards or even into Biscay (Lockley 1953). This view was moderated later by Perrins & Brooke (1976), who thought that the breeding birds might not go quite so far south, and Stone et al (1994) who could not find evidence that breeding birds went into Biscay. The birds tracked during the current study hardly go south of Skomer at all, but show a strong tendency to head northwards in the Irish Sea; those reaching the Mull of Galloway must be making flights of up to 350kms each way, about half as far as if they went to central Biscay. This journey involves some 16 hours of flying time for the round trip.

These initial studies are throwing up lots of other questions, some of which we are trying to answer:

(i) Was Lockley wrong or have the birds moved their foraging areas in the half century between the studies?

(ii) Do the birds from different colonies forage in different places? Early studies from Copeland (Northern Ireland) seem to show that many of these forage in the same areas as the Skomer birds. Since these are much closer to Copeland, they have much shorter journeys.

(iii) Do the birds vary the length of their feeding trips as a result of their feeding success?

Geolocators

Our GPS devices record the position of the bird at two-hourly intervals and do so very precisely. But they can obtain only a small number of fixes before their battery runs down and so are unsuitable for tracking the movements throughout the non-breeding season. For this we used geolocators; these record the times of dawn and dusk and by comparing these with their internal clock it is possible to calculate the latitude and longitude of their position; they have an accuracy of about 200 kms in latitude, but provide a rather more accurate estimate of longitude. We used geolocators supplied by the British Antarctic Survey; these weighed 2.5g (later ones weigh only 1.5g) and were fitted to a plastic (darvic) leg ring. In 2006 we attached these to 12 birds (six breeding pairs); all 12 birds returned the following year. We left the geolocators on the birds

Richard Else

Mike Alexander

Areas used by Manx shearwaters breeding on Skomer (excl. feeding trips while breeding – see Fig.1). The birds used the Irish Sea during the breeding season and an area off Argentina in the winter (October to March), both marked in grey. The outward and return routes along the coast of South America probably overlap. The checkerboard areas are where some birds paused on their migratory journeys. The filled circle shows where the females go during egg-formation.

until the females had laid their eggs so as to see where they went during the period before egg-laying, when they are away from the colony for about two weeks.

Some results of this study have recently been published (Guilford et al 2009) and many more data are becoming available for birds marked in the 2007 season and recaptured in 2008. Some of the results are shown schematically in Fig 2. and the following is a summary of the main findings:

i) On their autumn migration, the birds headed more or less directly to South America.
ii) The wintering areas of all 12 birds was remarkably consistent, centred slightly north of 40°S and slightly east of 60°W; this is about 500 kms due south of Buenos Aires and considerably to the south of where most of the ringing recoveries have come from (Thompson 2002).
iii) When returning to Skomer to breed, once past the easternmost point of Brazil, the birds veered westwards and returned to Skomer on a more westerly route than they used on the way down; some birds even approached the shores of the north-eastern United States quite closely before swinging eastwards.
iv) The average length of the southerly migration was 27 days for males and 37 days for females, while the average length of the northerly journey was 43 days for males and 28 days for females.
v) The speed of the journeys was very variable with one bird covering about 7,750 kms in seven days, but others taking much longer. This rapid movement involves an average speed of approaching 50km/hr, which is faster than the normal cruising speed of the Manx shearwaters

(c.40 km/hr, Pennycuick 1969), so it is probable that the bird benefitted from a strong following wind for part of the journey.

vi) A number of the birds which took longer to cover the distance seemed to stop en route, remaining in one area for c 10-14 days. This happened on both the outward and return journeys.

vii) After returning to the colony, the females left again during the two week period prior to laying the egg, heading westwards into the Atlantic to an area about 500 kms south-west of the south-western tip of Ireland. The males remained close to the colony, in line with earlier observations (eg. Brooke 1990) that they frequently returned to the nesting burrow while the female was away.

Conservation

Manx shearwaters receive little protection when they are away from the breeding sites. In part at least this is because the birds spend much of their time in international waters. But at present, even within UK territorial waters, the marine habitats of Manx shearwaters are scarcely protected at all. In the UK, the only Marine SPA is in Carmarthen Bay and affords almost no protection for shearwaters, since they are not abundant in that area.

Enhanced protection at sea may come about in two different ways. First the number of SPAs protecting breeding colonies may be increased and these may be extended further offshore so as to include areas where the birds assemble on the sea. This enhancement of the legislation is unlikely to be of great benefit to the Manx shearwater which does not normally feed close to the colony. It could, however, be important in protecting the areas where large rafts build up in the evenings, waiting to come ashore after dark. These are commonly 2-5 kms offshore. Nevertheless, GPS tracking suggests that many breeding birds do not always utilise these evening raft areas, coming ashore much later at night and flying in directly from greater distances (Guilford et al 2008, Fig. 9).

The UK Government has recently announced plans for making more Marine SPAs and these could

caption

provide important protection for the Manx shearwater, particularly if they are made in conjunction with similar ones by the Irish Government. On the available evidence the Manx shearwaters from Skomer spend most of the breeding season in waters belonging to these two nations, though this is less likely to be true of the colonies in Scotland and Western Ireland.

Beyond territorial waters, there is no protection on their journeys to, from or on their wintering areas, nor while they are making stopovers en route. Neither is there any protection in the areas where females go to feed after returning from migration when they are building their egg, areas which are themselves as yet poorly characterised. The future conservation of vulnerable species with such wider-ranging habits as the Manx shearwater will require a fuller understanding of the areas of sea they use, bearing in mind that resources – and hence resource use - may be changing, together with co-operation at a super-national scale to provide greater protection of marine habitats. The use of devices, such as those reported here, provides an opportunity to know where these areas are to a much greater accuracy than was possible hitherto.

Professor Christopher Perrins *LVO FRS was Director of the Edward Grey Institute of Field Ornithology, University of Oxford until he retired in 2002. His main studies have involved great and blue tits in*

Wytham Woods near Oxford, mute swans on the Thames and in Dorset, and seabirds on Skokholm and Skomer which he has been visiting since 1963.

Acknowledgements
I am grateful to CCW, the Wildlife Trust for South and West Wales and JNCC for permission to study on Skomer and for continued help and support. The study reported here was done in conjunction with Prof T. Guilford, Dr. J. Meada and D. Boyle to whom I am grateful for allowing me to use the material here.

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Dysgu er mwyn diogelu

Mae 90% o boblogaeth fyd eang yr aderyn drycin Manaw yn nythu ym Mhrydain ac Iwerddon. Ac mae 160,000 pâr, sef hanner poblogaeth y byd, yn nythu yng Nghymru. Rhaid dysgu llawer mwy am berthynas yr adar hyn â'r môr os am eu gwarchod yn llwyddiannus.

Mae technegau tracio soffistigedig yn ei gwneud hi'n haws i gasglu gwybodaeth am yr adar y tu hwnt i'w nythfeydd. Drwy osod teclynnau ar gefn adar drycin Manaw o Ynys Sgomer, gwelwyd eu bod yn dueddol o grynhoi i fwydo mewn tair ardal ym Môr Iwerddon yn ystod y tymor magu, yn hytrach nag ym Mae Biscay, fel y tybiwyd flynyddoedd yn ôl. A thrwy ddefnyddio teclynnau 'geoleoli' ar fodrwyon yr adar, dysgwyd eu bod yn mudo'n syth i Dde America yn yr hydref, ac yn gaeafu mewn ardal forol i'r de o Buenos Aires. Ar gyfartaledd, maent yn hedfan yno ar gyflymder o 40km/awr a bydd rhai yn oedi am gyfnod o 10-14 diwrnod ar y ffordd.

Cymerant rhyw fis i gyrraedd, ond mae'r ceiliogod, ar gyfartaledd, yn cyrraedd 10 diwrnod yn gynt na'r ieir. Wedi dychwelyd, mae'r ieir yn hedfan i ardal i'r de-orllewin o Iwerddon ac yn bwydo yno am bythefnos cyn dodwy tra bo'r ceiliogod yn aros yn agosach at y nythfa.

Nid yw'r moroedd a ddefnyddir gan adar drycin Manaw yn cael eu diogelu'n ddigonol. Byddai ymestyn Ardaloedd Gwarchod Arbennig (AGA) oddi ar y lan yn help i warchod y rafftiau adar sy'n aros i ddod i'r tir gyda'r nos. Ond ni fyddai'n gwarchod ardaloedd bwydo'r adar, gan fod y rhain yn bellach i ffwrdd, ac nid pob aderyn chwaith sy'n ymuno â'r rafftiau fin nos. Gallai creu AGA morol penodol fod yn fuddiol, yn enwedig o safbwynt adar Sgomer, pe bai'n digwydd ar y cyd ag Iwerddon fel bod yr ardaloedd bwydo pwysig yn cael eu cynnwys. Ond mae gwarchod y moroedd a'r mannau gorffwyso ar hyd llwybrau mudo'r adar yn fwy fyth o her.

Glowing ghosts of the sea...

This is one of the equal-first entries in our 'Inspired by Nature' essay competition, and is an appropriate topic in the year that the Marine Bill is included in the government's draft legislative programme. ***DAVID WRIGHT*** *tells us about a group of marine animals which resemble jellyfish, but are really quite distinct.*

Rohan Holt

(caption)

Anyone with even a passing interest in the natural history of Wales knows about the red squirrels of Anglesey, the ospreys of Glaslyn, the dolphins of Cardigan Bay and the research and conservation efforts that accompany these charismatic wonders. However, Wales' rich zoological diversity includes many more unfamiliar and, perhaps, bizarre animals that are just as fascinating and deserving of our attention. Within the coastal waters of Wales and in oceans worldwide exists such an enigmatic group; a group of gelatinous, ovoid animals known as the ctenophores or 'comb jellies'. But what are these animals; what do they do and why are they a continuing source of scientific interest and debate?

Some unusual comb jelly characteristics

Superficially, ctenophores resemble those other well-known jelly-like marine animals; the cnidarians or jellyfish. They are similarly almost transparent and mostly radially symmetrical, but lack the jellyfish's stinging cells. They earned their name from the eight comb-like rows of cilia, or ctenes, which run down the body and can contain in excess of 1000 cilia each. These sets of tiny cilia beat in complex patterns, creating a novel method of propulsion. Although ctenophores can reach up to around 1.5m in some oceans of the world, those found around Wales are more generally 2-15cm long.

Voracious predators, comb jellies consume most types of zooplankton in the water column, including crustaceans, fish eggs and even each other. They can have dramatic effects on the health and composition of marine ecosystems, if they occur in sufficient numbers. They capture prey by a variety of different methods. These include trailing long tentacles bearing sticky granules to snare prey. Others lack tentacles altogether and simply pursue their prey through the water.

Ctenophores have varying reproductive strategies. Most are hermaphrodites and possess one testis and one ovary simultaneously. They mostly cross-fertilise in spawning events, although members of the genus *Mnemiopsis* are known to self-fertilise. By contrast, in other species individuals are either male or female. This has raised questions about the selective advantages of being a hermaphrodite[4]. Most comb jellies, regardless of their diverse adult shapes and sizes, produce juvenile life-stages that all look remarkably similar. Some of these become sexually active and reproduce, without ever maturing to the adult forms.

Another feature is that some are capable of 'post-regeneration', that is, they are able to re-grow parts of their bodies that have been damaged or completely removed. Many are bioluminescent – they possess organs which produce fantastically coloured light displays, and many also possess crystal structures in their cilia that cause iridescence when the cilia beat. Surprisingly, the ctenophores lack any obvious photosensitive receptors with which to 'see' such wonderful displays.

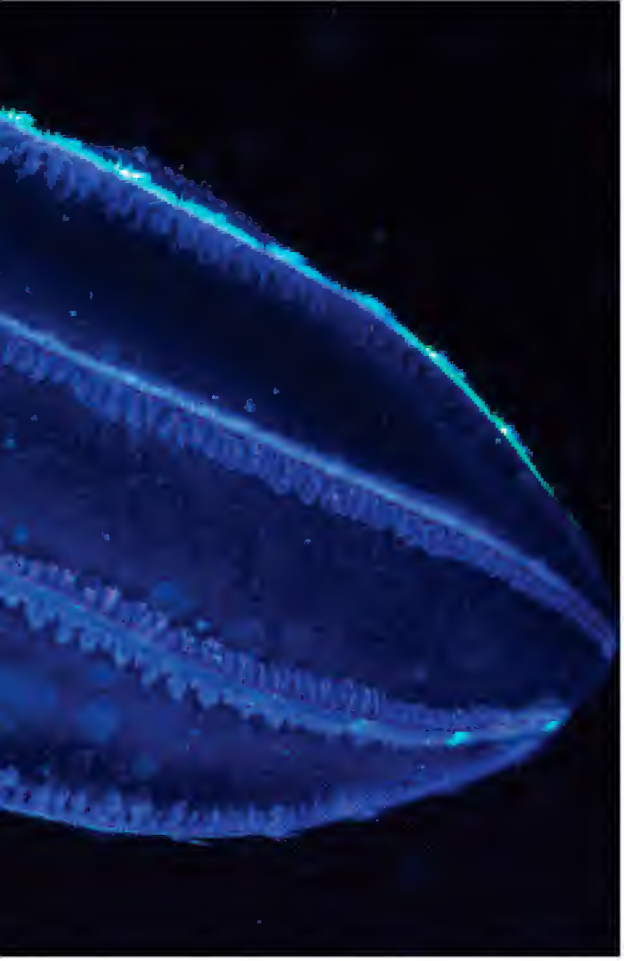
A little ctenophore classification...

Comb jellies are a taxonomic puzzle. Few taxonomists agree even on the number of species, with totals varying between 80 to more than 150 described. They have been classified according to the possession of tentacles, lobes, methods of cilia beating, feeding modes, reproduction strategies and similarity to other groups (such as the jellyfish). Searching for images of ctenophores on the internet will undoubtedly provide photographs of species labelled "undescribed" or "species unknown". You may well find them washed up on your local beach, yet we know so little about where they fit in the tree of life.

...and why are they important?

Recent genetic studies have shown that the comb jellies are not as 'primitive' or 'simple' as they might appear. Currently evidence suggests only vertebrates such as ourselves possess a higher number of an important group of genes that regulate development, known as SOX genes, than the comb jellies[7]. This completely overturns the idea that so-called 'simple' organisms should have less genetic information. They may yet raise intriguing questions about our understanding of the origins and evolution of animal life and how we perceive evolutionary relationships between the animals of today. Research into their ciliary locomotion is also underway, for use in human medicine and industry. Applications could include more efficient drug-delivery systems and microscopic mixing systems.

Environmentally, there is a possible use for ctenophores, along with the jellyfish, as indicators of climate change effects, as their distribution and abundance are highly sensitive to temperature. They are well documented as invasive species in areas where they have been accidentally introduced, such as the Black Sea. The result of ctenophore invasion can



be devastating for ecosystem function, native species survival and fisheries. Their ecosystem interactions are intricate and poorly understood, and more research is needed to enhance their use for monitoring the ever more threatened marine ecosystems.

There are so many fascinating and unusual aspects to the biology of the comb jellies which we currently don't understand. Yet there they are, all around the Welsh coast, playing important roles in our coastal ecosystems. It's so easy to overlook such wonderful creatures, particularly given their nearly transparent appearance, but these intriguing animals may yet prove to unravel some scientific puzzles and provide us with new technologies. We should strive to understand them as a wonderful and integral part of the zoological heritage of Wales.

***David Wright**, Bangor University*

Ysbrydion gwynias y môr...

Nid oes angen ichi ymddiddori'n frwd ym myd natur Cymru i fod wedi clywed am wiwerod coch Ynys Môn, gweilch Glaslyn, dolffiniaid Bae Ceredigion, a'r gwaith ymchwil a'r gwaith cadwraeth sy'n mynd law yn llaw â'r creaduriaid carismataidd yma. Ond mae amrywiaeth sŵolegol cyfoethog Cymru yn cynnwys llawer mwy o anifeiliaid anghyfarwydd – ac od, efallai – sydd yr un mor ddiddorol â'r rhain, ac sy'n haeddu sylw. Yn nyfroedd y glannau yng Nghymru, ac mewn moroedd ar hyd a lled y byd, mae un grŵp llawn dirgelwch i'w gael – grŵp o greaduriaid gludiog, siâp ŵy, a elwir yn gtenofforau neu'n 'slefrod cribog'. Ond beth yw'r anifeiliaid yma? Beth maen nhw'n ei wneud, a pham maen nhw'n destun diddordeb a thestun trafod di-baid ymhlith gwyddonwyr?

Rhai o nodweddion anarferol y slefrod cribog

Ar yr wyneb, mae ctenofforau'n debyg i anifeiliaid eraill sydd ar ffurf slefrod môr, sef y cnidariaid. Fel y rheini, maen nhw fwy neu lai'n gymesur a bron yn dryloyw, ond nid oes ganddynt gelloedd llosgol. Mae eu henw'n deillio o'r wyth rhes o flewiach, neu gilia (tebyg i grib), sy'n mynd i lawr eu cyrff. Gall pob rhes gynnwys dros 1000 o gilia'r un. Mae'r cyfresi yma o gilia bach yn curo mewn patrymau cymhleth, gan greu math gwahanol o yriant. Er bod y ctenofforau sydd i'w cael yn rhai o foroedd y byd yn gallu bod oddeutu 1.5m o hyd, tua 2-15cm o hyd yw'r rheini a welir o amgylch Cymru, fel arfer.

Mae slefrod cribog yn ysglyfaethwyr barus, gan fwyta'r rhan fwyaf o fathau o sŵoplancton yn y golofn ddŵr, gan gynnwys cramenogion, wyau pysgod, a hyd yn oed ei gilydd. Os oes digon ohonynt yn y dŵr, gallant gael effaith ddramatig ar iechyd a chyfansoddiad ecosystemau morol. Maen nhw'n dal eu hysglyfaeth mewn amryw o wahanol ffyrdd. Er enghraifft, mae ganddynt dentaclau hir sydd â gronynnau gludiog arnynt, a gallant lusgo'r rhain ar eu hôl i ddal eu hysglyfaeth. Nid oes gan bob un o'r slefrod cribog dentaclau o'r fath, felly mae'r rhain yn dilyn eu hysglyfaeth drwy'r dŵr.

Mae gan y ctenofforau fwy nag un ffordd o

atgenhedlu. Deurywiaid yw'r rhan fwyaf ohonynt, gydag un gaill ac un ofari. Gan amlaf, maen nhw'n croesffrwythloni trwy silio, er bod aelodau'r rhywogaeth Mnemiopsis yn gallu hunanffrwythloni. Mewn cyferbyniad â hyn, mewn rhywogaethau eraill mae'r unigolion naill ai'n wryw neu'n fenyw. Mae hyn wedi codi cwestiynau ynglŷn â'r manteision o fod yn ddeurywiad[4]. Mae gan y rhan fwyaf o slefrod cribog, ni waeth be fo'u ffurf na'u maint llawndwf, fwy nag un cyfnod fel slefrod ifanc, ac mae'r cyfnodau yma i gyd yn debyg iawn i'w gilydd. Bydd rhai o'r slefrod cribog yn dechrau gweithredu'n rhywiol ac yn atgynhyrchu heb droi'n ffurfiau llawndwf o gwbl.

Nodwedd arall yw bod rhai ohonynt yn gallu 'ôl-adfywio' – hynny yw, maen nhw'n gallu aildyfu rhannau o'u cyrff sydd wedi'u niweidio neu wedi diflannu'n llwyr. Mae nifer ohonynt yn fio-ymoleuol – maen nhw'n meddu ar organau sy'n cynhyrchu arddangosfeydd o liwiau anhygoel, ac mae gan nifer ohonynt hefyd strwythurau crisial yn eu cilia sy'n creu lliwiau symudliw pan mae'r cilia'n curo. Yr hyn sy'n rhyfedd yw nad oes gan y ctenofforau unrhyw dderbynyddion ffotosensitif amlwg ar gyfer 'gweld' arddangosfeydd gwych fel y rhain.

Ymgais i ddosbarthu'r ctenofforau...

Mae slefrod cribog yn benbleth i'r tacsonomydd. Ychydig iawn o arbenigwyr sydd hyd yn oed yn cytuno ar faint o rywogaethau sydd i'w cael, gyda'r cyfanswm yn amrywio o 80 i fwy na 150. Cânt eu dosbarthu yn ôl y meini prawf canlynol: a oes ganddynt dentaclau neu labedau; dull y cilia o guro; ffyrdd o fwydo; dulliau atgenhedlu; a'u tebygrwydd i grwpiau eraill (fel slefrod môr). Wrth chwilio am luniau o gtenofforau ar y rhyngrwyd, fe fyddwch yn siŵr o weld ffotograffau o rywogaethau sydd "heb eu disgrifio" neu "rhywogaeth anhysbys". Efallai y dewch o hyd iddynt wedi'u golchi ar eich traeth lleol; ond yn anffodus, ychydig iawn a wyddom am eu lle yng nghoeden bywyd.

...a pham maen nhw'n bwysig?

Mae astudiaethau diweddar ar eneteg wedi dangos nad yw'r slefrod cribog mor 'gyntefig' neu 'syml' ag y tybir. Yn ôl y dystiolaeth sydd ar gael ar hyn o bryd, awgrymir mai dim ond creaduriaid asgwrn cefn fel ni sy'n meddu ar fwy o enynnau arbennig na'r slefrod cribog – sef genynnau o'r enw SOX sy'n rheoli datblygiad[7]. Dyma rywbeth, felly, sy'n gwrth-ddweud yn llwyr y syniad y dylai organeddau 'syml' fod â llai o wybodaeth enetig. Gall y creaduriaid yma godi cwestiynau diddorol am ein dealltwriaeth o darddiad ac esblygiad anifeiliaid a'r berthynas esblygol rhwng yr anifeiliaid sydd i'w cael heddiw. Hefyd, mae gwaith ymchwil yn cael ei wneud ar eu cilia, yn y gobaith y gellir defnyddio'r wybodaeth ym myd meddygaeth a diwydiant. Gallai'r defnyddiau posibl gynnwys systemau mwy effeithiol ar gyfer cyflwyno cyffuriau a systemau cymysgu microsgopig.

O safbwynt yr amgylchedd, fe allai'r ctenofforau a'r slefrod môr eraill fod yn ddefnyddiol fel arwyddion o effeithiau newid hinsawdd, gan fod eu dosbarthiad a'u nifer yn sensitif iawn i dymheredd. Ceir digonedd o dystiolaeth eu bod yn ymledu mewn ardaloedd lle cawsant eu cyflwyno drwy ddamwain, er enghraifft yn y Môr Du. Fe allai gweld y ctenofforau'n ymledu fod yn newyddion drwg iawn i ddull yr ecosystem o weithredu, yn ogystal ag i oroesiad rhywogaethau brodorol a physgodfeydd. Ychydig iawn a wyddom am ddulliau gweithredu cymhleth eu hecosystem, ac mae angen mwy o waith ymchwil er mwyn gwella'r defnydd y gellir ei wneud ohonynt o safbwynt monitro ecosystemau morol sydd dan fygythiad cynyddol.

Mae yna gymaint o agweddau hynod ac anarferol sy'n perthyn i fioleg y slefrod cribog na wyddom ddim amdanynt ar hyn o bryd. Eto i gyd, mae nhw i'w cael o amgylch glannau Cymru i gyd, gan chwarae rhan bwysig yn ein hecosystemau arfordirol. Hawdd iawn yw anwybyddu creaduriaid mor wych, yn arbennig gan eu bod bron yn dryloyw. Ond fe allai'r anifeiliaid diddorol yma lwyddo i ddatrys rhai posau gwyddonol, gan arwain at dechnoleg newydd a allai fod o fudd i ni. Dylem wneud ymdrech gwirioneddol i'w deall a'u derbyn fel rhan bwysig ac annatod o dreftadaeth sŵolegol Cymru.

***David Wright**, Prifysgol Bangol*

Guillemots on Skomer - a long term view

Mike Alexander

(caption)

It takes dedication, continuity and funding to keep long term studies going, all of which are hard to find. The guillemots on Skomer have been giving up their secrets for decades, and the result is a picture of endearing, sociable sophistication, and a crucial window onto the changing conditions at sea which human activities, from fishing to global warming, are causing, as ***TIM BIRKHEAD*** *explains.*

The common guillemot is an extraordinary bird whichever way you look at it. One of Britain's commonest seabirds, it is also one of the most obvious on a visit to Skomer Island. The dense masses of guillemots that fill the cliff ledges seem to lead chaotic lives, but nothing could be further from the truth. Close observation of colour-ringed birds, allowing us to recognise them as individuals, reveals a fascinating and surprisingly sophisticated lifestyle.

Our on-going studies started in the 1970s and are designed to help us understand what determines the size of the guillemot population on Skomer. To do that we need to know as much as possible about their lifestyle. Each summer since 1972, together with one or more researchers, I have been to Skomer to observe and record the birds' biology: how long they live; when they first start to breed; the timing of their breeding seasons; how successful their breeding is; what they feed their chicks on; and their social behaviour.

The most obvious thing about guillemots is how closely they are packed

Tim Birkhead

(caption)

together on their breeding ledges. No other bird breeds in such close proximity. The reason is safety in numbers. A densely packed phalanx of bills provides a perfect defence against predatory gulls or ravens that might steal their eggs or chicks. But such high density living requires rather special social skills and guillemots have a rich repertoire of displays and signals that allow them to maintain domestic stability. Each pair defends its own territory: a tiny space of just a few square centimetres in which they lay their single, large egg. The territory is essential for breeding and is vigorously and viciously defended. Guillemots make no nest and the egg is laid straight on to the rock. To minimise the chances of the egg rolling away, pairs adjust their incubation position to their territory's geological idiosyncrasies. Guillemots are long-lived and by returning to use the same territory year after year, they get to know it, and their immediate neighbours, extremely well.

Infidelity at a human scale

Serious fighting occurs mainly over infidelity. Like most birds, guillemots are socially monogamous and males and females form long-term relationships and work together to rear their offspring. But high density breeding provides opportunities for extra-pair matings – especially when one partner is away. Using DNA fingerprinting we found that about 7% of guillemot chicks are fathered by a male other than the one that raises them. This is quite high compared with most other seabirds, but low compared with many other birds.

Breeding starts in May, although the birds may have been on the ledges, on and off, since October. Guillemots lay a single egg that hatches after about 32 days, and the chick leaves the colony after a further 21 days. At this stage the young birds weigh about one third of adult body weight and cannot fly. They leave the colony at dusk, launching themselves off their cliff ledge onto the sea where they are met by their fathers who then care for them out at sea for a further few weeks. After that the young guillemots are on their own and disperse widely, but mainly in a southward direction as far as the Bay of Biscay.

Young guillemots never return to Skomer in their first year. In thirty or so years we have never seen a

first year bird at the colony. In their second year a few return, but they appear to be nervous and tend to remain on the water or tidal rocks below the breeding ledges. From their third year onwards they are rather more adventurous and visit the breeding ledges, usually close to where they were reared. In fact about half of all guillemot chicks ringed on Skomer return to breed in their natal subcolony. As with other long-lived birds, they enjoy a long period of adolescence and most of the birds we have ringed as chicks first start to breed when they about seven years old. The youngest bird we have found breeding was four, and we have some birds in their teens that have never acquired a partner or a territory.

Adolescence is when young guillemots visit other colonies – rather like guillemot gap years – and some of our birds have turned up in colonies in southern Ireland and as far away as the Isle of May on the east coast of Scotland. Most of these are simply visiting and if they survive will return to breed on Skomer. Some colony exchange does occur, and a few of Skomer's chicks have moved to other Welsh islands to breed. In 1997 we captured a breeding guillemot on Skomer that had been ringed as a chick in a colony at Stora Karlso, Sweden, in the Baltic!

Island passion

Long term studies rely on a sustained passion. I have loved Skomer ever since my first visit, and both I and my Sheffield-based collaborator, Professor Ben Hatchwell, are committed to Skomer's guillemots and their future. Studies like ours are difficult to sustain because most funding organisations take a very short-term view of any kind of project, so finding sufficient funds to employ field assistants and to keep up with the appropriate technology is a continuous pressure. Every year adds enormously to our knowledge, but also results in ever-increasing amounts of data. To deal with this we now have a customised database and we collect data in the field (on the cliff tops) using a hand-held computer from which we can download information at the end of each day. The other important aspect of a study like ours is continuity of methodology – doing things in the same way and to same high standard each year – so that our data are comparable between years. This requires careful training of field assistants, most of whom, fortunately, have been as committed as ourselves.

Tim Birkhead

(caption)

The study has many facets. Field work involves many hundreds of hours searching for colour-ringed birds since it is these re-sightings that allow us to estimate survival rates. Persistence really pays here: seeing the first 75% of breeding birds is relatively easy, but we must do better than that to estimate survival accurately, and spotting the tricky individuals at the back of densely-occupied ledges can take many hours of patient observation. It is also vital to maintain a good number of ringed birds, so once each year we ring both adult guillemots and chicks with a metal BTO ring and an engraved plastic colour ring (these are easier to read through a telescope). On Skomer, the average adult survival from one year to the next is about 95%, which means that most birds have a breeding lifespan of about 20 years. In years of poor survival, average breeding lifespan may drop as low as seven years, while in good years it may be over 30 years, so what appear to be tiny changes in annual survival, say from 97% to 93%, can have a huge impact on the population.

Measuring breeding success is another time-consuming but important aspect of the study. Experience with seabirds elsewhere shows that a change in productivity is often the first warning of imminent

Tim Birkhead

(caption)

Tim Birkhead

problems. Spotting eggs and following their fortunes through incubation, hatching and nestling stages until they leave the colony is an important piece in the guillemot jigsaw.

For long-lived birds like the guillemot, life span is the single most important factor determining whether the population increases, decreases or remains the same. One important factor reducing survival is oil. Oil spills, such as the *Aegean Sea* (1992), *Sea Empress* (1996), *Erika* (1999) and *Prestige* (2002), often hundreds of kilometres from Skomer but in regions where birds over-winter, all resulted in a decrease in adult guillemot survival.

In addition to this, climate change is also having a negative effect on how long our guillemots live. Recent results show that the more extreme the North Atlantic Oscillation (NAO) is, the lower the guillemot survival rate. Positive NAO indices mean warmer, wetter and windier winters – and these conditions seem not only to reduce the guillemot's survival, but also to delay the start of the breeding season. Later breeding seasons usually result in lower breeding success. Overall, increasing NAO values are not good news for guillemots.

Recovering numbers

When I started studying guillemots on Skomer in 1972 numbers were at their lowest level ever, with about 3500 individuals. Numbers had been higher (about 5000 individuals) when David Saunders, the first Skomer Warden, started the whole island counts in 1962, and they had been higher still in the 1930s. In 1934 Ronald Lockley took a series of photographs of the one of the largest guillemot colonies (the Wick) using a large plate camera. Although the resolution is good on these photographs, it isn't quite good enough to count individual birds. Nonetheless, one can see that the numbers of birds in 1934 was enormous, with the birds forming a continuous line along the main ledge that runs along the length of the Wick. I also have located photographs of a few areas of cliff taken in 1890 that also indicate a very large guillemot population, including birds breeding in places where they no longer breed.

Since 1980 the Skomer guillemots have been increasing steadily and in 2008 numbers stood at about 20,000 individuals. This is an extremely encouraging trend, although it is important to note that comparing areas today with those photographed in the 1890s and 1930s indicates that we still have a long way to go before we achieve a full recovery.

The increase of guillemots on Skomer is wonderful

and the island's cliffs are now much more exciting than they were thirty years ago when I first went to Skomer. In the 1970s the colonies were full of nervous, jittery birds that were desperately vulnerable to predatory gulls. Today, Skomer's guillemot colonies hum with reassuring confidence born of safety in numbers.

However, we should not be complacent. The increase we have seen since the 1980s might well be fuelled by over-fishing: the removal of larger predatory fish that allows smaller prey species like sprats to increase and thereby provide an abundant food supply for species like guillemots. Equally plausible is the fact that climate change (such as NAO) might have driven changes in prey species numbers, and fuelled the guillemot increase. Perhaps both over-fishing and climate change are working in unison – we don't know.

Elsewhere around the UK coast guillemots are having a very tough time. In Shetland, Fair Isle and the North Sea over-fishing may well be responsible for the catastrophic decline in sandeels (the guillemot's main prey there), with resulting starvation of chicks, mass breeding failure and plummeting numbers. We are living in a period of rapid human-induced environmental change; yet we still have a poor understanding of the impacts of such change on the marine environment and on those animals, like seabirds, that live at the interface of land and sea. Continued, high quality monitoring of guillemot population parameters on Skomer is essential if we are to be in a position to detect any deleterious effects, understand the processes behind them, and advocate measures to minimise their impact.

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Mike Alexander

Gwylio gwylogiaid Sgomer

Does na'r un aderyn arall sy'n nythu'n dyrfa mor glòs â gwylogiaid. Mae'r mur o bigau main yn amddiffyniad gwych yn erbyn cigfrain a gwylanod. Ond rhaid cael trefn a sgiliau arbennig i fyw fel hyn ac mae gwylogiaid yn feistri ar gynnal sefydlogrwydd cymdeithasol. Mae pob pâr yn amddiffyn tiriogaeth sydd ond ychydig o gentimedrau sgwâr; dônt yn ôl i'r un man bob blwyddyn ac maen nhw'n 'nabod y llecyn a'u cymdogion yn dda iawn. Rhaid i bob aderyn ganfod ffordd arbennig o ori'r wy sy'n cael ei ddodwy'n syth ar y graig ac er yn barau triw ar y cyfan, gall ymladd ffyrnig ddigwydd os bydd ymdrechion i baru gydag adar eraill. Ar Sgomer, ni ddaw'r cywion yn ôl yn ystod eu blwyddyn gyntaf ond bydd tua hanner ohonynt yn dychwelyd i fagu pan fyddant tua saith oed.

Mae gwaith maes ar Sgomer ers 1972 wedi dangos bod gwylogiaid yn byw am 20 mlynedd, ar gyfartaledd. Mesurir llwyddiant bridio, sy'n gallu bod yn arwydd cynnar o unrhyw broblemau. Er mai hyd oes yw'r dylanwad pennaf ar faint poblogaeth mae ffactorau fel llygredd a newid hinsawdd yn bwysig hefyd; gwyddwn bod gaeafau cynhesach, gwlypach a mwy gwyntog yn gohirio'r tymor magu ac yn lleihau goroesiad yr adar. Cynyddu mae gwylogiaid Sgomer, er nad ydynt wedi cyrraedd y niferoedd anferthol y welwyd yn 1934, ond nid yw'r darlun yr un peth ym mhob man.

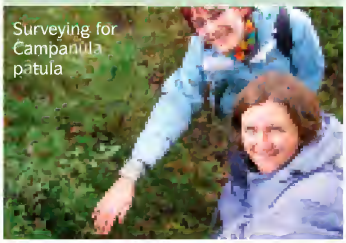
Natasha de Vere

Conserving Wales' rarest plants

at the National Botanic Garden of Wales

Campanula patula

The world's plant diversity is under threat. Botanic gardens around the world can use their expertise to benefit threatened plants. Here ***NATASHA DE VERE*** *describes what the National Botanic Garden of Wales is doing to conserve some of Wales' rarest plants.*



Surveying for Campanula patula

Alastair Hotchkiss

It is estimated that up to 100,000 plants, representing more than one third of the world's plant species, are currently threatened or face extinction in the wild. Botanic gardens are working to protect plants from all around the world but a priority must always be with the plants in one's own country. I started work at the National Botanic Garden of Wales in October 2007, with funding provided by the Countryside Council for Wales; a major part of my job is to help conserve some of the most threatened plant species in Wales.

So are scarce plants in Wales doing any better than in the rest of the world? A new 'red list' describes the conservation status of rare Welsh plants, and offers a partial answer. This has been produced by Dr Trevor Dines from the wild plant conservation charity Plantlife, with the help of the plant recorders from the Botanical Society of the British Isles and the Countryside Council for Wales. You can download a copy of the red list from Plantlife's website (**http://www.plantlife.org.uk/uk/plantlife-wales-publications.html**).

So how are the plants of Wales doing? Of the 1467 species found in Wales, 2.6% are extinct, 17.5% are threatened with extinction (varying from species that are vulnerable to those that are critically endangered), 5.5% are near to being threatened and for 2.3% we do not have enough information to judge at the moment. With about a quarter under threat, they clearly need our help.

Rare Welsh Plants Project

How can we help to conserve these threatened plants? Here at the National Botanic Garden we are working on the Rare Welsh Plants Project to conserve some of these threatened species. The Project is a collaboration between the botanic garden and the National Museum of Wales, with the two institutions leading on different species. For each individual species we work with a range of conservation and research organisations including the Countryside Council for Wales, Plantlife, Botanical Society of the British Isles, the Whitley Wildlife Conservation Trust, Chester Zoo, Exeter University, Aberystwyth University and Manchester University.

The first step is to know why a plant is threatened in the first place – from changes in land-use, competition from invasive species or climate change, for example. We then need to find out about its ecology – longevity, recruitment of young plants to the population and so on - by studying it in the wild and growing it in the botanic garden where we can look more closely at its lifecycle.

Once we understand the ecology of the plant and why it is threatened we can put together a plan for how to protect it. We might suggest changes to the grazing regime at a rare plant locality, and, if the population is very low, we might want to grow the plant within the botanic garden. This would provide a 'safety net' so that if the plant becomes extinct in the wild at least we have not lost it forever. This is however a last resort and not suitable for all species.

At the moment the National Botanic Garden is working on 15 species as part of the Project. Here are some examples that illustrate the range of approaches that we use.

Alastair Hotchkiss

Cotoneaster cambricus on the Great Orme

Wild cotoneaster - *Cotoneaster cambricus*

The only site in the world for this plant is the Great Orme, Caernarvonshire, where there are only six original plants left in the wild, clinging to wind-swept limestone crags. One of these plants had been propagated and used to reintroduce some new individuals but the remaining five plants have never been cultivated. With so few plants in the wild it was felt that having representatives of all six individuals in cultivation was important. In order to do this, horticulture teams from the National Botanic Garden of Wales and Chester Zoo met on the Great Orme to propagate the wild cotoneaster using air-layering. This involved making a cut in the stem that is packed with moist moss and covered with waterproof plastic. Over the coming months new roots will hopefully develop from the cut stem and we can remove the 'new' plants.

We also have some research to carry out on this species. At the moment very few of the plants produce berries in the wild and no natural regeneration has been observed. We need to find out more about its ecology to see why it is not reproducing successfully. There is also some doubt about the taxonomic status of wild cotoneaster. It could be an introduction, and this would put the need for its conservation in doubt. We will be working with

Alastair Hotchkiss

Rhingia camprestris feeding on *Campanula patula*

Aberystwyth University to look at its DNA and some of its relatives to try to unravel this problem, using funding from Chester Zoo.

Spreading bellflower - *Campanula patula*

This rare plant is found in the wild in sunken lanes and woodland tracks in the Welsh borders. It is endangered in the UK and critically endangered in Wales, but very little is known about its ecology, and without this information we cannot conserve it. Along with Plantlife and the Botanical Society of the British Isles we are starting to fill in some of the gaps in our knowledge of this species. In 2008 we conducted a survey of many of its historical sites in Wales and some in England. We found spreading bellflower in only three of the 18 sites we visited in Wales and two out of the five sites in England.

Spreading bellflower is a difficult plant to study; it will 'disappear' from a site and then new plants will appear decades later, presumably after having lain dormant in the seed bank for all of those years. We do not know exactly what makes the plant reappear but high levels of disturbance in the soil seem to be important and this is something we will be investigating in more detail. As well as studying this plant in the wild, we have also acquired seed from the Millennium Seed Bank which we are germinating so that we can follow its lifecycle at closer quarters.

Alastair Hotchkiss

Sorbus leyana

Endemic whitebeams – *Sorbus species*

Some of the whitebeam trees found here are endemic to Wales, not occurring anywhere else in the world, and are critically endangered. For example, Ley's whitebeam *Sorbus leyana* is found only on two cliff faces in the Brecon Beacons with only 17 trees in total. Tim Rich at the National Museum of Wales has worked on endemic whitebeams for many years and has ensured that the botanic garden has an excellent collection; he is currently producing a Sorbus handbook, to be published by the Botanical Society of the British Isles, that will cover all of the British and Irish species. In order to learn more about these species and how to conserve them we are going to look at the DNA of some of the Welsh species to find out more about how they originated. We are also helping with a PhD project being carried out at the Whitley Wildlife Conservation Trust and Exeter University, to find out about the origins and conservation of the whitebeam species endemic to south-west England.

Meadow thistle – *Cirsium dissectum*

The meadow thistle is an example of a species that has declined substantially throughout its range in Britain and NW Europe, as its habitat has been lost. It can be found in Rhos pasture, a wet grassland habitat that is of particular conservation importance in Wales. I have been carrying out research on this species for a number of years, looking at how the habitat influences how well the plant does and the amount of genetic variation that it contains. The results illustrate how complex natural systems are and how much we need to know to conserve even a single species within them.

In under-grazed meadow thistle sites, that have lots of tall vegetation, the meadow thistle produces lots

of flowers and seeds but those seeds are unable to establish, as there is no room for them in the dense sward. Eventually the older plants die and are not replaced. At the other extreme, in sites that are heavily grazed or mown there are lots of areas of bare soil where seeds can establish, but in these sites the meadow thistle does not seem to be able to flower, so seeds are not produced. At either extreme, sexual reproduction cannot occur, genetic variation in the population is gradually lost and the plants suffer. The correct management therefore needs to allow heterogeneity in the habitat ensuring that flowering can occur whilst there are areas of bare soil so that seedlings can establish.

The next chapter in the meadow thistle story involves looking at another factor that may threaten it in the wild – hybridisation. Meadow thistle frequently hybridises with the much more common marsh thistle *Cirsium palustre* but the implications of this hybridisation have never been studied. Does hybridisation have a negative effect on the meadow thistle as it becomes swamped by the commoner marsh thistle's genes? Alternatively, does hybridisation have a positive effect leading to greater genetic variation in meadow thistle populations? Or is hybridisation so rare that is makes no difference at all! In order to answer these questions we will be studying meadow and marsh thistles in the wild and also carrying out experiments here at the botanic garden.

For each of the plant species studied in the Project we want to provide information that will directly help to conserve that species in the wild. Once work on one species is complete we will prioritise new species that we think we can help. Beyond that, by studying these individual plant species, we hope to begin to build up a bigger picture about how to conserve threatened plants in general.

Dr Natasha de Vere *is Head of Conservation and Research at the National Botanic Garden, Wales.*

Natasha de Vere

Cirsium dissectum

Ar y dibyn

Cyfanswm o 1467 rhywogaeth o blanhigion sy'n tyfu yng Nghymru. Mae tua chwarter ohonynt dan fygythiad. Bwriad Prosiect Planhigion Prin Cymru yw helpu'r planhigion hyn i oroesi.. Rhaid dysgu am ecoleg planhigyn, a'r rhesymau pam ei fod dan fygythiad, cyn y gellir creu cynllun gweithredu ar ei gyfer. Pymtheg rhywogaeth sydd dan sylw ar hyn o bryd ac mae rhai mewn perygl mawr, fel 17 coeden gerddin y Darren Fach sydd ond yn tyfu mewn dau le ar glogwyni Bannau Brycheiniog a chotoneaster y Gogarth nad yw'n tyfu mewn unrhyw le arall yn y byd. Mae'r cynlluniau'n gymysgedd o waith ymarferol, fel lluosogi un o'r chwe planhigyn cotoneaster ar y Gogarth, a gwaith ymchwil hefyd.Er enghraifft, bwriedir astudio mwy ynglŷn ag effaith aflonyddiad pridd ar lwyddiant y clychlys ymledol, ac mae ymchwil eisoes wedi dangos bod rhaid i lystyfiant rhos fod â strwythur amrywiol er mwyn i ysgallen y ddôl flodeuo a chynhyrchu hadau sy'n egino. Mewn achosion prin yr ystyrir tyfu rhywogaeth yn yr ardd fotaneg – rhag ofn y bydd popeth arall yn methu.

Collecting Cotoneaster cambricus for DNA

Natasha de Vere

Awr y Ddaear 2009: Cofrestrwch a diffoddwch

Am 8.30pm ar 28 Mawrth 2009, bydd hyd at un biliwn o bobl ledled y byd yn diffodd eu goleuadau am awr yn yr arddangosiad mwyaf erioed o gefnogaeth i weithredu ar y newid yn yr hinsawdd. Bydd cartrefi, busnesau ac adeiladau a strwythurau amlwg mewn mwy na 1,000 o ddinasoedd yn tywyllu, gan anfon neges drawiadol iawn i arweinwyr y byd - dim ond trwy ddiffodd y goleuadau.

Mae'r newid yn yr hinsawdd yn bygwth cymunedau dynol ledled y byd, ac mae'n ychwanegu at y llu o bwysau sydd ar ein bywyd gwyllt yma yng Nghymru. Mae Cyngor Cefn Gwlad Cymru'n astudio sut y bydd efallai'n effeithio ar rywogaethau a chynefinoedd a sut y bydd y dirwedd efallai'n newid. Mae llawer o sefydliadau, gan gynnwys Comisiwn Cymru ar y Newid yn yr Hinsawdd, yn gweithio ar atebion, ond nid yw newid yn digwydd yn ddigon cyflym eto: bydd y penderfyniadau a wnawn yn 2009 yn penderfynu a fyddwn yn llwyddo neu'n methu.

Mae unigolion sy'n pryderu am hyn yn dechrau ymateb. Mae llawer ohonom yn gwneud ein rhan, ac mae'n hawdd arbed ynni. Ond dychmygwch bŵer pawb yn gwneud un peth bach symbolaidd ar yr un pryd! Dyma beth yw diben Awr y Ddaear. Gall pobl yng Nghymru ymuno ag unigolion a chymunedau o fwy na 60 o wledydd o gwmpas y byd mewn awr o weithredu trawiadol ar y newid yn yr hinsawdd. Mae Awr y Ddaear, sy'n cael ei threfnu gan WWF, yn ffordd syml i bobl ddangos eu bod yn pryderu. Gallai hefyd fod yn gyfle i gael ychydig o hwyl trwy drefnu cinio yng ngolau canhwyllau neu gyngerdd acwstig i godi arian!

Mae hefyd angen i'r llywodraeth weithredu, a 2009 yw'r flwyddyn bwysicaf erioed i'n hinsawdd, gyda thrafodaethau'r Cenhedloedd Unedig yn dod i ben yn Copenhagen ym mis Tachwedd. Gall pawb sy'n cofrestru ar gyfer Awr y Ddaear ddod yn rhan o'r lobi dros gytundeb rhyngwladol grymus ar frys i gymryd lle cytundeb Kyoto. Mae Jane Davidson, y Gweinidog dros Dai, Cynaliadwyedd a'r Amgylchedd, a deithiodd i Wlad Pwyl ar drên yn ddiweddar i gynrychioli Cymru yn y gynhadledd ar y newid yn yr hinsawdd, wedi ymrwymo i nodau Awr y Ddaear. Wrth roi ei chefnogaeth i'r fenter dywedodd: "Mae Llywodraeth Cynulliad Cymru'n cefnogi Awr y Ddaear fel ffordd syml ond grymus o ddangos sut y gall pawb chwarae ei ran yn y frwydr yn erbyn y newid yn yr hinsawdd."

Dechreuodd y fenter hon yn Sydney, Awstralia yn 2007 fel peth i godi ymwybyddiaeth. Yn 2008, aeth yn ddigwyddiad byd-eang trawiadol pan ddiffoddodd mwy na 50 miliwn o bobl mewn mwy na 270 o ddinasoedd mewn mwy na 35 o wledydd eu goleuadau am awr. Tywyllodd adeiladau amlwg fel Pont y Borth Aur yn San Francisco, Tŷ Opera Sydney, y Colisëwm yn Rhufain, Palas Buckingham a Phier Brighton yn y DU, y Tivoli yn Copenhagen a Gwesty Jumeirah yn Dwbai. Hyd yn hyn yn 2009 mae Canolfan Mileniwm Cymru, adeilad y Senedd, Gwesty St David's ac Amgueddfa Genedlaethol Cymru'n cefnogi Awr Ddaear WWF 2009.

Cofrestrwch am Awr y Ddaear trwy fynd i wwf.org.uk/earthhourwales. Gellir gwylio fideo byr am Awr y Ddaear i'ch ysbrydoli ar **wwf.org.uk/earthhour** – mae'n werth ei wylio!

KIM RICHARDS, WWF Cymru

Sydney before...

Earth Hour 2009: Sign up and switch off

At 8.30pm on 28 March 2009, up to a billion people across the world will switch off their lights for 60 minutes in the biggest ever demonstration of support for action on climate change. Homes, businesses and iconic landmarks in more than 1,000 cities will go dark, sending a very dramatic message to world leaders – simply by turning the lights off.

Climate change threatens human communities across the world, and is adding to the many pressures on our wildlife here in Wales. The Countryside Council for Wales is studying how species and habitats may be affected and how the landscape may change. Many organisations, including the Welsh Climate Change Commission, are working on solutions, but change is not yet happening quickly enough: the decisions we take in 2009 will determine whether we succeed or fail.

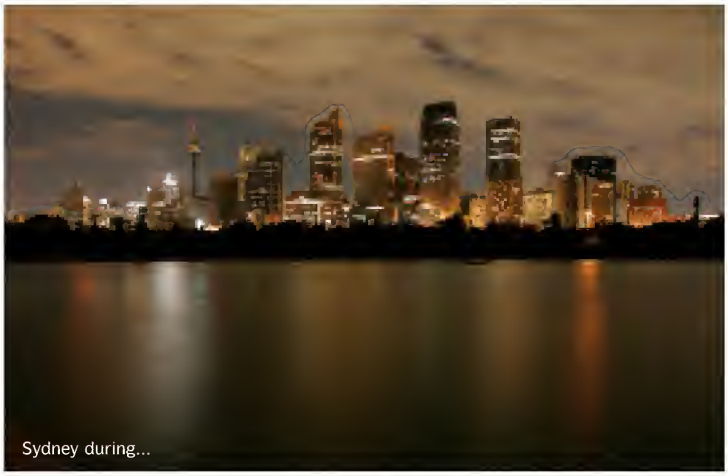
Concerned individuals are beginning to respond. Many of us do our bit, and saving energy is an easy thing to do. But imagine the power of everyone taking one small symbolic action simultaneously! That's what Earth Hour is all about. People in Wales can join concerned individuals and communities from over 60 countries around the world in a dramatic hour of action on climate change. Organised by WWF, Earth Hour is a simple way for people to show their concern: it could also be an opportunity to have some fun by organising a fundraising candlelit dinner or an acoustic concert!

Government action is also needed, and 2009 is the most important year ever for our climate with UN negotiations concluding in Copenhagen in November. Everyone signed up to Earth Hour can become part of the lobby for an urgent and powerful international agreement to replace Kyoto. Jane Davidson, Minister for Housing, Sustainability and the Environment, who recently travelled by train to Poland to represent Wales at the climate change conference, is committed to the aims of Earth Hour. In throwing her support behind the initiative she said: "The Welsh Assembly Government is supporting Earth Hour as a simple yet powerful way to demonstrate how everyone can play their part in the fight against climate change."

This initiative began in Sydney, Australia, in 2007 as an awareness-raising exercise. In 2008, it went spectacularly global when more than 50 million people in more than 270 cities in over 35 countries turned off their lights for one hour. Iconic buildings such as San Francisco's Golden Gate Bridge, Sydney's Opera House, Rome's Coliseum, Buckingham Palace and Brighton Pier in the UK, The Tivoli in Copenhagen and The Jumeirah Hotel in Dubai went dark. So far in 2009 Wales' Millennium Centre, the Sennedd building, St David's Hotel and the National Museum for Wales are supporting WWF's Earth Hour 2009.

Sign up to Earth Hour by visiting wwf.org.uk/earthhourwales. A short inspirational video on Earth Hour can also be viewed at **wwf.org.uk/earthhour** – it's well worth a watch!

KIM RICHARDS, WWF Cymru


Sydney during...

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ATLAS OF THE FLEAS (SIPHONAPTERA) OF BRITAIN AND IRELAND
RS George
FSC Publications 2008
£8.00

Fifty-six years and counting, few other naturalists can compare in dedication with Bob George, who has been studying fleas across six decades, a remarkable record, the fruits of which he brings to our attention in this excellent atlas.

It started when his Gloucester city centre flat was a thoroughfare for house mice travelling between a restaurant and a butcher's shop. Thirty-five mice trapped in three nights, from one of which he collected 15 fleas. Most of us would have removed the mice and missed the fleas, instead George despatched the latter to Tring where two species were identified, one, *Nosopsyllus londiniensis*, only the eighth record for Britain. Together with fleas taken from the nest of a long-tailed tit, within a few days he added four species to the Gloucestershire list. Fired by this and encouraged by Frans Smit and the Hon. Miriam Rothschild he gave up beetles and switched to fleas – in his own words "the temptation to adding new knowledge on the British fauna was too great ... Fleas had one great advantage over beetles – there was little competition."

In 1964 George became the National Recorder for Siphonaptera, one of the first national recording schemes to be set up under the Biological Records Centre. Since then he has identified several hundreds of thousands of fleas, enabled hundreds of new 10km square records to be made, and now has made this wealth of knowledge easily accessible with the publication of this Atlas, and additionally over the internet via the National Biodiversity Network Gateway.

Some 62 species and sub-species of flea occur in Britain and Ireland of which 43 have been recorded in Wales. The first on the list is *Pulex irritans* the human flea - that for the Marloes peninsula during the late 1960s taken from this author's cat! There has been only one record since 1975. Incidentally, the cat flea *Ctenocephalides felis* is one of the most widely distributed fleas in the Principality. Very restricted, not surprisingly, is the shearwater flea *Ornithopsylla laetitae* recorded from Bardsey, Skokholm and Skomer – but not since 1975, so scope here for island wardens (and what about Ramsey?) to update the records.

In addition to the maps, each with a short explanatory note, there are sections ranging from 'What are fleas' and ' Why study fleas', to their hosts, collecting and recording fleas. The comprehensive bibliography is dominated by no fewer than 49 papers by George himself in publications ranging from *Nature in Wales* to the *Entomologists Gazette*.

Browsing the first rate distribution maps one is immediately struck by the wealth of records from just over the Welsh border in Shropshire. Here dedicated collecting by one person, who has contributed over 40,000 fleas in fifteen years, has transformed our understanding of flea distribution. Enthused by Bob George's fine Atlas maybe one or more such persons could set to in Wales: the challenge, the opportunity is there to add new knowledge, with little competition so it seems.

David Saunders

WHERE TO WATCH BIRDS – WALES
David Saunders and Jon Green
Christopher Helm
2008
£16.99

This is the fourth incarnation of a book that I suspect will be on many Welsh birdwatcher's shelves already. So in a world where birding information is widely available on the internet, why bother buying a book you probably already own?

Well, for starters, it's been completely reset, with an improved format that makes it a lot easier to read. Its pages are graced by new line drawings, most of which are very good indeed; the garganey on page 226 is exquisite. But, most importantly, it has a large number of new sites. Some 108 are covered in the fourth edition. That's 40 more than the previous version and more than double the number in the

original 1987 edition. Moreover, some chapters have been expanded to make them more comprehensive. For instance, the chapter in the first edition entitled 'Worm's Head' has become 'South Gower Coast'.

The usual well-known coastal sites - the Bardseys and the Skomers - are still here, of course, but I was most encouraged by the increasing emphasis on inland locations. For instance, Breconshire only had three sites in the original edition; now it has seven. It was particularly pleasing to see the Brechfa and Crychan Forests of Carmarthenshire get their own chapter. These locations, rarely visited by birdwatchers, or indeed naturalists of any kind, represent the best chance for birders to break new ground. Who knows what you might find?

The new birding realities are also included, with the arrival of Dartford warbler and little egret. The book was published in 2008, yet still managed a mention of the Bonaparte's gull found on the Ogmore Estuary in January 2008, and the Pacific diver at Llys y Fran in 2007 and 2008. The book also reflects the new birding geography, with an extensive chapter devoted to the Newport Wetlands Reserve. But whole sections have been copied from previous editions and, occasionally, chapters show their age. The section on the upper Tywi valley states that 'most birdwatchers come to the upper Tywi valley in the hope of seeing red kites'. Considering that there are now over 1200 pairs of kites in the UK, I doubt that very much. The same chapter claims that afforestation of the uplands with conifers remains a threat to the species, a suggestion that is about 30 years out of date.

Although it is hard to think of many locations that have been left out, the book still inexplicably ignores Crymlyn Bog NNR in Swansea, the largest area of fen in south Wales. It would also have been nice to see more inland sites in Meirionnydd mentioned, perhaps the Rhinogydd or Coed y Brenin, to balance the emphasis on coastal sites. But these are minor quibbles for a book that is now a comprehensive introduction to birding in the Principality.

If you already have the third edition of this book, it would be hard to justify £17 for an extra 40 sites. And if you do your birding locally, you can probably get all the information you need from your local bird club website. But for the birder who travels, and visitors to Wales, this is essential reading, providing detailed information on the well-known, and not so well-known, sites throughout Wales.

Andrew Lucas

IN HER ELEMENT
Edited by Jane MacNamee
Honno 2008
£7.99

There are 23 contributors to this anthology of writing by women about the Welsh landscape. Inevitably heterogeneous, this collection of essays about the impact the landscape has on the lives of these writers contains some absolute delights. Each essay is short enough to be consumed in a moment, perhaps during a coffee break or over a quiet glass of wine before the fire; and if an essay doesn't fit your mood, the next one probably will.

The first essay, *Walking Through* by Christine Evans, is beautifully written and carries huge emotional impact. Others, such as Jane Matthews' *Skomer Log*, convey what it is like to be part of an extraordinary co-evolutionary journey, alongside puffins and seals. These are favourites, sufficient reason to cherish this collection.

There are common threads, weather being an ever-changing constant. Rocks and mountain tops challenge and call; rivers and sea lend lives a dynamic. These are more than settings, they have personality and spirit. Lyrical and introspective, not without a few blemishes, the best essays acknowledge the independence of nature. Less successful are the writers who use landscape as in a mirror, or a screen onto which to project themselves. Whether artfully poetic, or pointedly down to earth, together these essays are more than the sum of their parts; they are an expression of the presence of external nature in the innermost recesses of the human being.

James Robertson

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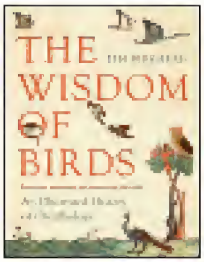


THE WISDOM OF BIRDS
Tim Birkhead
Bloomsbury
2008
Hardback
£25.00

The topic of this book is clearly shown in the sub-title *An Illustrated History of Ornithology*. It is an account of the great ideas in ornithology, and who discovered them. The author is a researcher and teacher in behavioural ecology (and the history of science) at Sheffield University, with interests ranging from magpies (on which he wrote an excellent monograph in the Poyser series), to seabirds and sperm competition.

The great ideas are covered in nine chapters, including obvious topics such as migration, territory, birdsong and sex, and perhaps more surprising ones such as *From Bird to Egg*, *Infidelity* (reflecting the author's research interests), and *Light and the Breeding Cycle*. Closely-argued explanations in the text are supported by notes which precede the comprehensive bibliography, allowing the reader to consult the original sources. Many topics were new to me; did you know, for example, that bird-trappers used decoy birds which were 'stopped' so that they sang in autumn, and so attracted migrants to the nets? This 'stopping' was achieved by gradually reducing the light for the captive decoys from May until August, thus accelerating their annual cycle so that by September they thought it was spring, and were in full song.

There are many heroes in this book, starting with Aristotle, but Tim Birkhead's choice as the most influential ornithologist is John Ray, whose book *The Wisdom of God* (published in 1691) transformed the way people viewed the natural world. He also provided the first useful classification of birds. As we are to hear plenty about Darwin and natural selection in 2009, *The Wisdom of Birds* will help provide the wider picture.

Wales does get a mention in connection with John Ray, as in 1662 he and Francis Willughby visited a number of British islands, including Priestholm (Puffin Island), Bardsey and Caldey. The Welsh naturalist Pennant entered the controversy about bird migration in 1768, writing in support of swallows migrating rather than diving head-first into ponds for the winter.

The Wisdom of Birds is well illustrated with plates from bird books over the ages, and is excellent value at £25. It would have made an excellent addition to the *New Naturalist* series, but the gap was recently filled by Peter Bircham's *A History of Ornithology* (2007). This is confined to the British scene, thus excluding many of the main players in the current volume, and is expensive (in hardback) at £45. So I heartily recommend Birkhead's book. If you cannot afford either, an earlier volume in the same field is James Fisher's *The Shell Bird Book* (1966), available from second-hand bookshops for 'a song'!

David Saunders

THE BIRDS OF MONTGOMERYSHIRE
Welshpool, Powys:
Powysland Club, 2008.

Readers venturing into Mont, perhaps visiting the Vyrnwy reserve or Dolydd Hafren, might like a copy of the Birds of Montgomeryshire, just out. Authors Brayton Holt and Graham Williams have lived in the county for many years, and are thus well-qualified to produce this volume. After sections on the history of bird recording in Mont and four attractive habitat photos by the first author, the bulk of the book is a detailed systematic list. This is well referenced so that readers can follow up surveys of individual species, such as (for example) those carried out by the county's active Barn Owl Group. There are no distribution maps or species vignettes, which helps to explain why the price is only £6. Available for £7 including P&P from **Brayton Holt, Scops Cottage, Pentrebeirdd, Welshpool SY21 9DL**.

Geoff Gibbs

Marine matters

During pre-legislative scrutiny by a joint Lords and Commons Committee the long-awaited Marine Bill came in for significant criticism for leaving too much to Statutory Orders or executive interpretation. This seems an appropriate moment to look at a recent case where obligations to protect features in a Welsh marine area under several existing measures have conflicted with and been compromised by a major development. While activists brought publicity to the pipeline route across south Wales from the Liquefied Natural Gas (LNG) terminal on Milford Haven, less attention was attracted to impacts on sensitive marine habitats.

Maerl

It happens that the only significant bed of maerl in Wales is crossed by the jetty at the South Hook LNG Terminal. Maerl is a Breton term used for the calcareous nodules produced by several species of coralline red algae. At the initial environmental impact assessment stage, consideration seems only to have been given to the consequences of minor refurbishment of the deck of a former oil jetty. Later, major reconstruction was decided upon. This required the use of jack-up barges, numerous anchor points for them, and tugs operating in such shallow water that propeller wash also disturbed the sea bed. Effects were thus spread much more widely than the corridor of the jetty itself.

Maerl only grows at tenths of a millimetre per year, so given the numbers and depths of the pits made by the spuds of the jack-up barges, the damage to this important feature of the Pembroke Marine SAC can be considered significant and long-lasting. At the landward end the jetty also crosses a bed of the eelgrass *Zostera marina*. Sea-grass beds are listed in the Habitats Directive and with maerl they are included as high priority features in an Annex to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic.

To convert the refrigerated LNG into gas for onward transmission requires considerable amounts of heat. This is achieved by submerged combustion vaporisers resulting in an effluent discharge containing significant amounts of nitrates. Preparatory studies for the Water Framework Directive of nutrient loading in Milford Haven had shown the system to be mesotrophic. One of the manifestations of eutrophication in sheltered estuaries is the growth of mats of opportunistic green algae over intertidal sediments. Guidance on Appropriate Assessments in SAC and SPA Estuaries highlighted this with a matrix indicating levels of coverage and degrees of concern. Several of the creeks leading off Milford Haven have already developed enough of these mats to imply risk. The new discharge permit from the LNG terminal is for maxima of 100kg of nitrates per day and an annual mean of 50kg per day. Put in context, this is equivalent to the load from another moderate sized urban sewage works. As there is evidence that both maerl and *Zostera* are sensitive to increased nutrient levels, the situation will at least need regular monitoring.

Ivor Rees

Hysbysfwrdd / Noticeboard

If you would like your wildlife event to feature on these pages please contact us on 01248 387373 or email info@naturcymru.org.uk (entries may be edited). Please mention Natur Cymru if you attend any of these events.

Plas Tan y Bwlch

Canolfan Astudiaethau a Gwasanaethau Addysg / Environmental Studies and Education Centre

PROFESSIONAL TRAINING COURSES

20-22 Apr *Phase 1 Habitat Survey*
29-30 Apr *Project Management*
4-6 May *Introduction to Environmental, Cultural & Historic Site Interpretation*
6-8 May *Wildlife & Development - An Introduction*
11-15 May *Tree Care, Protection & Management for Amenity & Development*
11-15 May *Introduction to the NVC*
1-5 Jun *Wildlife Surveying for Protected & BAP Species*
15-19 Jun *Grazing for Site Conservation Management*
29 Jun-3 Jul *Woodland Conservation Management*

Details **www.plastanybwlch.com** or **01766 772600**

School of Education and Lifelong Learning, Aberystwyth

COURSES IN 2009

Breeding Birds of Coast and Estuary, Welsh Wildlife Centre, Cilgerran, Pembs, 5 sessions from **20 Apr.**

Landscapes and their Conservation, Aberystwyth University, 4 sessions from **11 May.**

Identifying the Flowering Plants, **26-28 Jun** Denmark Farm Conservation Centre, Lampeter & **3-5 Jul** CAT, Machynlleth.

Butterfly Survey, Denmark Farm Conservation Centre, Lampeter, 4 sessions from **14 Jul**

Entomology: The Larger Insects of Wales, Welsh Wildlife Centre, Cilgerran, Pembs, 4 sessions from **1 Aug.**

For details of all courses contact: **learning@aber.ac.uk, 01970 621580**, or see **www.aber.ac.uk/sell**

Moelyci Environmental Centre, Bangor

COURSES AND EVENTS

Here's a taster of some of the things we offer, our full listing includes surveying, woodworking, map skills and crafts. Please contact **01248 602793**, **www.moelyci.org** **office@moelyci.org**

Every Tuesday - *Composting volunteer day*
Every Wednesday - *Conservation volunteering*
Every Thursday - *Market Garden*
22-26 Jun *Conservation volunteering week*

Children's Activities

Aimed at 6-12 year olds, accompanied by an adult. Wear old clothes and wellies! Booking Essential.

19 Apr *Life in the water* 10.30 – 12.30
17 May *Moelyci moths* 10.30 – 12.30
21 Jun *Creatures of the soil* 10.30 – 12.30

Conservation

27 Apr-1 May *Bird Watching Week*
21-22 May *Identification – Heathlands*
28 May *Farm Walk* 10-3.30pm
3-4 Jun *Idenitfication – Montane Habitats*

Fenn's, Whixhall & Bettisfield Mosses NNR

EVENTS

31 Mar *All of a Flutter*, moth & butterfly illustrated talk, 6.30pm, NEWI **www.wrexhamsf.com**
26 Mar-4 Apr *Exhibition & guided walks*, Bettisfield Church Mosses and Fenn's Moss 10-4pm. **www.wrexhamsf.com**
26 & 27 Apr *Birds of the Mosses* guided walk. Meet 2pm, Manor House NNR Reserve base, Whixhall.
10 May *Water Vole Workshop* 1pm, meet Bettisfield Village Hall.
24 May *Amphibian & Reptile Hunt*, meet 9am, Manor House NNR Reserve base, Whixhall.
13 Jun *Marvellous Moths of the Mosses guided walk*. Meet 2pm at Morris' Bridge, Whixall Moss NNR car park.

Caroline Evans **01743 282000** **caroline.evans@naturalengland.org.uk** or Joan Daniels **01948 880362**, **joan.daniels@naturalengland.org.uk**

Wales Biodiversity Partnership

WALES BIODIVERSITY WEEK

6-14 Jun

An annual week of wildlife-themed events, mostly free, ranging from small guided walks to large fairs where thousands of people can learn about biodiversity and the environment. For more details phone **Sean McHugh 01656 726984** or see **www.biodiversitywales.org.uk**

WBP CONFERENCE

16-17 Sept *Celebrating Success* University of Glamorgan. **www.biodiversitywales.org.uk**

OTHER EVENTS

For full listings visit the WBP website events calendar

Open University in Wales and National Museum Cardiff

Darwin's 200th birthday

18 Mar *Deceptive Dinobirds - The Final Revolution* Lunchtime talk
Apr – date to be confirmed *Evolution Megalab launch* **www.evolutionmegalab.org**
6 May *Conflict and Co-operation, Opening Darwin's jar of Evolution* Lunchtime talk, Dr Steve Morris.
9-16 May *Adult Learner's Week*

All events FREE of charge, at National Museum Cardiff, Cathays Park, Cardiff CF10 3NP **www3.open.ac.uk/contact/events.aspx** **www.open.ac.uk/wales** **Tel (029) 2047 1170** **www.museumwales.ac.uk/en/cardiff/** **(029) 2039 7951**

Exhibition

TUNNICLIFFE & HIS LEGACY

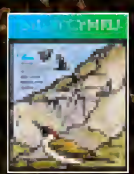
2 May for 6 weeks. A celebratory exhibition of some of the works of **CF Tunnicliffe**, alongside three of Wales' most respected contemporary wildlife painters, **Kim Atkinson**, **Terence Lambert** & **Philip Snow**. The exhibition will primarily focus on Welsh wildlife, landscape & country, with Tunnicliffe's Anglesey work the centrepiece. **Plas Newydd, Brynsiencyn, Anglesey.**

Castle Rock

Mike Alexander

Diolch am y lluniau i / For illustrations, thanks to:
Mandy Marsh, Natural England,
Alastair Robertson, Philip Snow

Back issues of *Natur Cymru* (Nos 2 - 29) are available priced £3.00



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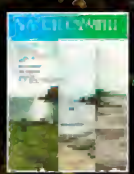

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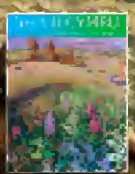

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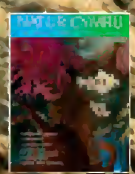

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James Robertson

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